Appendix C

Industri Plex
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RECORD OF DECISION

SDMS DocID 70376

INDUSTRI-PLEX SUPERFUND SITE OPERABLE UNIT-2
(AND INCLUDING WELLS G&H SUPERFUND SITE OPERABLE UNIT-3,
ABERJONA RIVER STUDY)

CITY OF WOBURN
MIDDLESEX COUNTY, MASSACHUSETTS

Prepared by:

United States Environmental Protection Agency
New England Region – Region 1
One Congress Street
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JANUARY 2006

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DECLARATION FOR THE RECORD OF DECISION

PART 1: THE DECLARATION

A. SITE NAME AND LOCATION

Industri-plex Superfund Site Operable Unit 2 (and including Wells G&H Superfund Site Operable Unit 3, Aberjona River Study)
Woburn, Massachusetts
Middlesex County
EPA Identification Numbers:
Industri-plex - MAD076580950
Wells G&H - MAD980732168

B. STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Industri-plex Superfund Site Operable Unit 2 (and including the Wells G&H Superfund Site Operable Unit 3, Aberjona River Study) ("Industri-plex OU-2"), in Woburn, Massachusetts, which was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), 42 USC § 9601 et seq., as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300 et seq., as amended. The Director of the Office of Site Remediation and Restoration (OSRR) has been delegated the authority to approve this Record of Decision.

This decision was based on the Administrative Record, which has been developed in accordance with Section 113 (k) of CERCLA, and which is available for review at the Woburn Public Library, 45 Pleasant Street, Woburn, Massachusetts and at the United States Environmental Protection Agency (EPA) Region 1 OSRR Records Center in Boston, Massachusetts. The Administrative Record Index (Appendix E to the ROD) identifies each of the items comprising the Administrative Record upon insert which the selection of the remedial action is based.

The Commonwealth of Massachusetts concurs with the Selected Remedy.

C. ASSESSMENT OF THE SITE

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

D. DESCRIPTION OF THE SELECTED REMEDY

This ROD sets forth the selected remedy for Industri-plex OU-2, which is the final operable unit for the Industri-plex Superfund Site. Other operable units remain at the Wells G&H Superfund Site. The first phase of Industri-plex, Operable Unit 1, or Industri-plex OU-1, addressed soil, groundwater (interim action only), on-site sediment, and air contamination at Industri-plex OU-1. This final phase, Operable Unit 2, addresses principal and low-level threats at Industri-plex OU-2 in groundwater, soil, sediment and surface water contamination to the extent that such threats exist.

The selected remedy is a comprehensive approach for Industri-plex OU-2 that addresses all current and potential future risks caused by contaminated groundwater, soil, sediment, and surface water. Specifically, this remedial action addresses contamination in:

Groundwater originating at Industri-plex OU-1 and extending to the Halls Brook Holding Area Pond (HBHA Pond);

Sediments in the HBHA Pond, HBHA Wetlands, Wells G&H Wetland, and Cranberry Bog Conservation Area;

Surface and subsurface soil in the vicinity of the former (now buried) Mishawum Lake; and

Surface water in the HBHA Pond.

The remedial measures will prevent future unacceptable risks from sediments and soils, and untreated groundwater and surface water, and will allow for restoration of Industri-plex OU-2 to beneficial uses. Institutional controls will be required to prevent unacceptable exposures to hazardous substances and contaminated materials in groundwater, soils, and deeper wetland sediments in the future. Also, long-term monitoring, operation and maintenance, and periodic five-year remedy reviews will be performed.

The major components of this remedy are:

- Dredging and off-site disposal of contaminated sediments in the southern portion of the HBHA Pond; dredging and off-site disposal of contaminated near shore sediments at the Wells G&H Wetland and Cranberry Bog Conservation Area; and restoration of all disturbed areas. This component will address sediments posing unacceptable human health risks for near shore sediments and unacceptable ecological risks for the southern portion of HBHA Pond.

• Use of the northern portion of HBHA Pond as a sediment retention area (primary and secondary treatment cells) that will intercept contaminated groundwater plumes (including arsenic, benzene, ammonia, 1,2-dichloroethane, trichloroethene, naphthalene) from Industri-plex OU-1, treat/sequester contaminants of concern (including arsenic, benzene, ammonia), and minimize downstream migration of contaminants (including arsenic, benzene, ammonia). The primary treatment cell will intercept the contaminated groundwater plumes discharging in the HBHA Pond. The effluent from northern portion of the HBHA Pond (secondary treatment cell outlet) will serve as the surface water compliance boundary, and achieve National Recommended Water Quality Criteria (NRWQC). Sediments which accumulate in the northern portion of the HBHA Pond will be periodically dredged and sent off-site for disposal. Portions of storm water from Halls Brook, which may interfere with the natural treatment processes occurring within the northern portion of the HBHA Pond, will be diverted to the southern portion of HBHA Pond.

• If necessary, In-situ Enhanced Bioremediation of contaminated groundwater plumes (e.g., benzene) at the West Hide Pile (WHP).

• Construction of an impermeable cap to line stream channels (e.g. New Boston Street Drainway), and to prevent the discharge of contaminated groundwater plumes, contamination of stream sediments, downstream migration of contaminants of concern, and potential impacts to other components of the selected remedy.

• Construction of a permeable cap to prevent contaminated soil erosion (e.g. Area A6), downstream migration of contaminants of concern, and potential impacts to other components of the selected remedy.

• Establishing institutional controls to restrict contact with soils, groundwater, or deeper interior wetland sediments with concentrations above cleanup standards and protect the remedy.

• Construction of compensatory wetlands for any loss of wetland functions and values associated with the selected remedy (e.g. northern portion of HBHA Pond, Halls Brook storm water by-pass, capped stream channels) nearby in the watershed.

• Long-term monitoring of the groundwater, surface water, and sediments, and periodic Five-year Reviews of the remedy.

The selected response action addresses principal and low-level threat wastes at Industri-plex OU-2. Principal threats to groundwater will be addressed by the management of migration and institutional controls; in soil by institutional controls and capping, in sediment by removal, off-site disposal, institutional controls, and providing an alternate habitat; in surface water by management of migration and providing an alternate habitat. To the extent that contamination remains on-site covered or capped, institutional controls will be put in place to prevent exposure in the future. The selected remedy is consistent with EPA's preferred alternative outlined in the June 2005 Proposed Plan and is consistent with a combination of all or a portion of Alternatives SS-2, SUB-2, GW-2, GW-4 for the West Hide Pile, HBHA-4, NS-4, DS-2, and SW-2, outlined in the June 2005 Feasibility Study. The estimated present worth cost of the remedy, including long-term operation, maintenance and monitoring, is approximately $25.6 million.

E. STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable.

Based on the size and location of the contaminated soil areas, EPA concluded that it was impracticable to excavate and treat the chemicals of concern in a cost-effective manner. Thus, the selected remedy does not satisfy the statutory preference for treatment as a principal element of the remedy

Because this remedy will result in hazardous substances remaining on-site above levels that allow for unlimited use and unrestricted exposure (and groundwater and/or land use restrictions are necessary), reviews will be conducted every five years after initiation of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

F. SPECIAL FINDINGS

Issuance of this ROD embodies specific determinations made by the Regional Administrator pursuant to CERCLA and section 404 of the Clean Water Act, 33 U.S.C. § 1251 et seq., the remedy is the least damaging practicable alternative for protecting aquatic ecosystems at the Industri-plex OU-2 under the standards of 40 CFR Part 230. At the HBHA Pond and the Wells G&H Wetland and Cranberry Bog Conservation Area, EPA expects impacts to wetlands and other waters, including the HBHA Pond and capped channels. EPA cannot identify a less damaging practicable alternative for each area which would avoid impacting the wetland areas while adequately addressing site risks.

Best management practices will be used throughout the clean up of this area of Industri-plex OU-2 to minimize adverse impacts on the wetlands and waters, wildlife and habitat. Damage to these wetlands will be mitigated through erosion control measures and proper re-grading and re-vegetation of the impacted area with indigenous species. Following excavation activities, wetlands will be enlarged, restored or replicated consistent with the requirements of the Federal and State wetlands protection laws.

Executive Order 11988 (Protection of Flood Plains) requires a determination that there is no practical alternative to taking federal actions in a flood plain area. Once that determination is made, the action taken must be designed or modified to minimize potential harm to or within the flood plain with the goal to minimize the impact of floods on human safety, health and welfare, and to restore and preserve natural and beneficial values served by flood plains. Sediments in a portion of the HBHA Pond and the Wells G&H Wetland and Cranberry Bog Conservation Area that pose an unacceptable human health and/or ecological risk are located in a flood plain. Through its analysis of the data collected in the RI as well as evaluations in the human health and ecological risk assessments, EPA has determined that because significant high level contamination exists in a portion of the flood plain in the HBHA Pond and the Wells G&H Wetland and Cranberry Bog Conservation Area, there is no practical alternative to conducting work in the flood plain. Once EPA determines that there is no practical alternative to conducting work in flood plain, the Agency is then required to minimize potential harm to or within the flood plain. The selected remedy for the HBHA Pond and the Wells G&H Wetland and Cranberry Bog Conservation Area requires excavation and removal of sediments that pose an unacceptable risk in the flood plain. Once those sediments have been excavated, the flood plain area will be restored such that there is no lost flood storage capacity.

G. ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this Record of Decision. Additional information can be found in the Administrative Record file for this Industri-plex OU-2, as well as the Industri-plex OU-1 and Wells G&H OU-1 Administrative Record files, which have been incorporated by reference into the Industri-plex OU-2 Administrative Record.

1. Chemicals of concern (COCs) and their respective concentrations.

2. Baseline risk represented by the COCs.

3. Cleanup standards established for COCs and the basis for the levels.

4. Current and future land and groundwater use assumptions used in the baseline risk assessment and ROD.

5. Land and groundwater use that will be available at the Industri-plex OU-2 as a result of the selected remedy.

6. Estimated capital, operation and maintenance (O&M), and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are projected.

7. Decisive factor(s) that led to selecting the remedy.

H. AUTHORIZING SIGNATURES

This ROD documents the selected remedy for contaminated groundwater, soil, sediment, and surface water at Operable Unit 2 of the Industri-plex Superfund Site (and including Wells G&H Superfund Site Operable Unit 3). This remedy was selected by the EPA with concurrence of the Commonwealth of Massachusetts Department of Environmental Protection (see Appendix A for Commonwealth of Massachusetts' concurrence letter).

Concur and recommended for immediate implementation:

U.S. Environmental Protection Agency

By: ______________________ Date: 01/31/06

Susan Studlien
Director
Office of Site Remediation and Restoration
Region 1

PART 2: THE DECISION SUMMARY

A. SITE NAME, LOCATION AND DESCRIPTION

- Site Name: Industri-plex Superfund Site Operable Unit 2 (and including Wells G&H Superfund Site Operable Unit 3, Aberjona River Study), Woburn, Massachusetts, 01801.
- Location: Woburn, Massachusetts
- National Superfund electronic database identification number, e.g., CERCLIS identification number: Industri-plex – MAD076580950, and Wells G&H – MAD980732168
- The current lead entity for Industri-plex Superfund Site Operable Unit 2 (and including Wells G&H Superfund Site Operable Unit 3, Aberjona River Study): EPA
- Site type: Former chemical and glue manufacturing facilities whose operations and waste disposal practices caused releases and downstream migration of contamination within the Aberjona River watershed.

Site Description

In 1983, EPA identified two Superfund sites along the Aberjona River in Woburn, Massachusetts: the Industri-plex and Wells G&H Superfund Sites.

Situated in north Woburn, the Industri-plex Superfund Site is primarily contaminated with metals (e.g., arsenic, lead, and chromium) and buried animal hide wastes. The original 1986 Record of Decision (ROD) and the 1989 Consent Decree governing the implementation of the ROD defined the Industri-plex Superfund Site as being comprised of 245 acres; the Consent Decree included a map which defined the site for its purposes. Under CERCLA and the National Contingency Plan, the parameters of the Industri-plex Superfund Site include any areas where hazardous substances originating from that Site have come to be located. 42 U.S.C. § 9601(9); 40 C.F.R. § 300.5. For purposes of this ROD, the terms "Site" or "Industri-plex Site" includes both operable units at Industri-plex (see Figure A-1 for approximate overall Industri-plex Site boundary and locus map). Where it is appropriate, EPA will refer to the Site as defined by the 1986 ROD and the 1989 Consent Decree as "Industri-plex OU-1" (see Figure A-2 for approximate Industri-plex OU-1 boundary), and to that portion of the Site covered by this ROD as "Industri-plex OU-2" (see Figure A-3 for approximate Industri-plex OU-2 boundary). It should be noted that Industri-plex OU-1 and OU-2 overlap in some areas covered under the original OU-1 ROD.

The original ROD and the Consent Decree for Industri-plex OU-1 required the investigation of the migration and impacts of site-related contamination (e.g., metals) on downstream areas, as well as the evaluation of potential sources of hazardous materials impacting the aquifer This Industri-plex OU-1 investigation is included in the area also referred to herein as the Northern Study Area.

The Wells G&H Superfund Site consists of approximately 330 acres situated in East Woburn, Massachusetts, and is located approximately 1 mile downstream of Industri-plex OU-1 along the Aberjona River (see Figure A-2 for approximate Wells G&H boundary). In 1979, contamination was discovered in two municipal wells, Wells G and H (installed in 1964 and 1967, respectively). The groundwater was contaminated with volatile organic compounds (VOCs), including trichloroethene (TCE) and tetrachloroethene (PCE) and, as a result, the wells were shut down. Contaminants found in site soils included polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyl compounds (PCBs), VOCs, and pesticides. Aberjona River sediments were found to be contaminated with heavy metals, including arsenic, chromium, mercury, and zinc, and some PAHs. The 1989 Wells G&H ROD specified a groundwater cleanup remedy for five source area properties contributing to VOC groundwater contamination (Operable Unit 1 (Wells G&H OU-1)). This Wells G&H ROD, along with a 1991 Explanation of Significant Differences and a 1991 Consent Decree designated two other operable units: the second operable unit (Wells G&H OU-2) is referred to as the Central Area Aquifer Study, and investigates the remaining groundwater; and the third operable unit (Wells G&H OU-3) is referred to as the Aberjona River Study and investigates surface water and sediment contamination along the river and its associated wetlands. This Wells G&H OU-3 investigation is also referred to as the Southern Study Area. Currently, Wells G&H OU-1 groundwater treatment activities are on-going at all five source area properties. Wells G&H OU-2 continues to be investigated.

As a result of the similar sediment contamination (e.g., metals such as arsenic) at the two Superfund sites, EPA merged the Wells G&H OU-3 into Industri-plex OU-2 to establish one comprehensive cleanup plan for the Aberjona River and associated wetlands. This investigation, which resulted in this ROD, is known as Industri-plex Superfund Site OU-2 (and including Wells G&H Superfund Site OU-3, Aberjona River Study) Comprehensive Multiple Source Groundwater Response Plan Remedial Investigation (MSGRP RI), as depicted on Figure A-4. This ROD will use the terminology "Industri-plex OU-2" to include Wells G&H OU-3, except as otherwise indicated.

Based upon the baseline risk assessment results and contaminant fate and transport mechanisms, as presented in the March 2005 Comprehensive MSGRP RI, October 2005 Technical Memorandum – Evaluation of Ammonia and Supplemental Soil Data (October 2005 Technical Memorandum), and the Administrative Record, the approximate boundaries of Industri-plex OU-2 are illustrated on Figure A-3.

Heavy metals are the principal contaminants of concern throughout Industri-plex OU-2, with arsenic representing the most significant metal present at elevated concentrations throughout the system. The most significant source of metals contamination has been from Industri-plex OU-1. Although the contaminated soils have been capped as part of the Industri-plex OU-1 remedy, they continue to impact groundwater at OU-1 and discharge inorganics (including dissolved arsenic) to the HBHA Pond, the HBHA Wetlands and the Aberjona River. Once contaminants are discharged from groundwater to the surface water bodies, sediments and surface water are impacted and the contaminants are transported further downstream.

Several organic contaminants (including benzene) were also detected in soils and groundwater in the Northern Study Area. Benzene was the most frequently detected VOC at concentrations exceeding state standards for groundwater. In addition to the inorganic and organic groundwater plumes, these plumes also include high concentrations of ammonia. The ammonia is primarily generated from the buried organic waste at Industri-plex OU-1 (e.g., animal hide waste). The ammonia, along with the inorganic and organic plumes, primarily discharge into the HBHA Pond, and contribute to sediment and surface water impacts in the pond.

Other organic compounds, such as naphthalene and trichloroethene (TCE), were also observed sporadically in groundwater samples in the vicinity of the HBHA Pond. TCE was also observed in another area approximately one half mile south of Industri-plex OU-1, generally located south and southwest of Cabot Road, in the vicinity of former Mishawum Lake. However, based on the available groundwater data, it appears that the source of the TCE south of Cabot Road is not related to Industri-plex OU-2.

A more complete description of Industri-plex OU-2 can be found in Section 1 of the MSGRP RI prepared by Tetra Tech NUS, Inc (TtNUS) for EPA, dated March 2005, and the October 2005 Technical Memorandum.

B. SITE HISTORY AND ENFORCEMENT ACTIVITIES

1. History of Site Activities

Site Ownership/Operations

Various manufacturing facilities operated on the Industri-plex OU-1 from 1853 to 1969. Prior to 1853, the Industri-plex OU-1 was undeveloped land, covered forest along the northern, upland border, and wetlands and marshy swampland over the southern two thirds of the property.

SUMMARY OF INDUSTRI-PLEX OU-1 OWNERSHIP (1853 – 1989)

Date	Ownership	Comments
Prior to 1853	Unknown	Natural undeveloped land.
1853 – 1863	Robert B. Eaton	Manufactured Hartshorn, Vitriol, Copperas, Glue, Gums, Nitrates.
1863 – 1929	Merrimac Chemical Co. (New England Manufacturing Co. made munitions from 1915 to 1920)	Manufactured many types of acids, tin crystals, oxy-muriate of antimony, arsenical pesticides. Waste products were arsenic, lead, zinc, copper and mercury.
1929 – 1931	Monsanto Chemical Co.	Similar products to Merrimac Chemical Co.
1931 – 1934	F&L Land Salvage and Improvement Co.	Salvage existing plant equipment.
1934 -1936	New England Chemical Industries, Inc.	Manufacture of animal glues, "technical gelatin"
1936 – 1961	Consolidated Chemicals Industries	Same products as previous owner.
1961 – 1969	Stauffer Chemical Co.	Same as previous owner.
1969 – 1989	Mark-Phillip Trust	Industrial developer.

From 1853 through 1931, Industri-plex OU-1 was home to various chemical manufacturing operations that produced chemicals for the local textile, leather and paper industries; the main products being sulfuric acid and related chemicals. Other chemicals produced at this facility included arsenic insecticides, acetic acid, dry colors, and organic chemicals including phenol, benzene, picric acid, toluene, and trinitrotoluene (TNT). Beginning in 1935, the plant was dedicated to the manufacturing of glue from animal hides until mid-1969 when operations ceased and the property was vacated.

The waste products resulting from 115 years of industrial activities were randomly disposed of on-site. Prior to 1934, it appears that waste materials were disposed of over a wide area, encompassing all of the property owned by Merrimac Chemical Company west of the current location of Commerce Way, including the property west of the railroad tracks. It appears that the wastes were used for two purposes. The first use was to fill lowlands, wetlands and shallow ponds in order to provide more useable land on which to locate new processes. The second use was as a construction material used to build dikes and levees to contain liquid wastes in a particular area. After 1934 and for the remainder of industrial operations, the disposal of waste products was generally limited to areas east and southeast of the main plant. These wastes were deposited directly on top of the existing deposits and reached heights in excess of forty feet above natural grade. The locations of the operations are depicted in the March 2005 MSGRP RI and Industri-plex OU-1 Administrative Record

In December 1968, the Mark-Phillip Trust (MPT or the Trust) purchased approximately 149 acres of the property from Stauffer Chemical Company, while others purchased the remaining 35 acres. The MPT intended to develop the Stauffer land, along with land owned to the south and east, as an industrial park to be called "Industri-plex 128." From early 1970 to 1979, development activities involved filling and excavating portions of the property to facilitate the sale of various parcels. Excavations uncovered chemical and glue manufacturing wastes, including decaying animal hides. In addition to two existing waste stockpiles (i.e., East Central Hide Pile and South Hide Pile), some of these waste deposits were excavated and either trucked off-site, buried on the southern Boston Edison Company (BECO, n/k/a NSTAR) right-of-way, or stockpiled in two new waste piles (i.e., West and East Hide Piles).

<u>Regulatory Enforcement Activities</u>

The Commonwealth of Massachusetts has a long history of enforcement actions against the MPT arising out of its development of the property. These actions began in August of 1969 when the developer began work without the proper permits from the Massachusetts Department of Natural Resources (DNR). In December 1970, the DNR issued a permit to the Trust; the permit acknowledged the existence of the former Stauffer wastewater treatment lagoon and disposal area and required that they be addressed in compliance with current state regulations. In addition, after repeated violations of administrative orders issued by the Department of Environmental Quality Engineering (DEQE, n/k/a DEP), a state court issued an injunction sought by the Commonwealth and the Town of Reading, preventing certain development activities.

Federal involvement began in June 1979 when the United States Attorney's Office, on behalf of the U.S. Army Corps of Engineers (COE) and EPA, filed suit against the MPT alleging violations of § 404 of the Federal Water Pollution Control Act, which regulates the filling of wetlands. An injunction was issued and further development activity stopped. In support of this injunction, EPA provided the results of its soil and water testing at the property, which showed that hazardous substances, primarily arsenic, chromium and lead sludges, had been released. Negotiations between the MPT and the state and federal regulatory agencies began and continued until May 1985, when separate state and federal Consent Decrees were approved by their respective courts. The decrees, similar in scope, required the Trust to undertake a series of steps, including investigations to determine the nature and extent of the hazardous waste problems, cleaning up the hazardous waste problems and resolving the wetland filling issues. In exchange, the MPT would be able to develop certain pieces of the property in order to generate enough revenue to continue with the remedial investigations and clean up. Citing the inability to generate sufficient capital, the MPT has never complied with the terms of the Consent Decrees.

The Industri-plex Site was listed on the Superfund Interim List of 115 Top Priority Hazardous Waste Sites in 1981 and on the Superfund National Priorities List in 1983.

In May, 1982, the DEQE and EPA entered into a Consent Order with Stauffer Chemical Company to undertake a Remedial Investigation/Feasibility Study (RI/FS) and subject to certain conditions to pay for its apportioned share of the remedial actions. Stauffer began implementing the Consent Order in the summer of 1982 with Phase I of a RI and completed the RI/FS process in April 1985 with the submission of the Phase II RI/FS.

Two early response actions were undertaken at Industri-plex OU-1. The first, conducted by the DEQE in November 1980 involved a sprayed latex cover over a large exposed arsenic and lead deposit to minimize air entrainment of arsenic and lead dust. In the summer of 1981, EPA undertook a removal action by installing a chain link fence around Industri-plex OU-1 to prevent unauthorized access. A subsequent action was undertaken in June 1986 to repair the existing fence.

Based upon investigations in the early 1980s, EPA established a 1986 Record of Decision for the first phase of cleanup at Industri-plex OU-1, which included the construction of protective caps over approximately 110 acres of soils contaminated with heavy metals and animal wastes (permeable cap over approximately 105 acres, impermeable cap over approximately 5 acres) to prevent people from coming into contact with the contamination. The installation of the protective caps was completed in 1998, and the industrial park is currently home to retail, commercial and light industry land uses, as well as the Anderson Regional Transportation Center. Industri-plex OU-1 also included a gas collection and treatment system, institutional controls, and interim groundwater remedy, as well as further investigations of site-related contamination at and downstream of Industri-plex OU-1. In addition, as noted above, the 1986 ROD required further investigation to support a second decision regarding the impacts of groundwater and surface water contamination from Industri-plex OU-1. This investigation contributes to the basis for this ROD.

On April 24, 1989, EPA entered into a Consent Decree with 26 Settling Parties to perform the Industri-plex OU-1 Remedial Design/ Remedial Action. The Industri-plex Site Remedial Trust (ISRT) was created as a requirement of the 1989 Consent Decree for the 26 Settling Defendants (current and previous landowners) to form a single entity responsible for funding, managing, and administering the remediation at Industri-plex OU-1 and fulfilling the obligations of the Consent Decree. Since the 1989 Consent Decree, the ISRT has performed many of the investigations to support the RI/FS.

The Settling Parties have been very active in generating data to support the MSGRP RI and MSGRP FS, participating in technical discussions regarding contaminants at the Industri-plex OU-2, and providing technical comments on the baseline risk assessments, MSGRP RI, MSGRP FS and Proposed Plan. Some of their activities are presented above and below in Part 2, Sections B and C, and include extensive review and comment on EPA's March 2003 Wells G&H Superfund Site OU-3 Aberjona River Study Baseline Human Health Risk Assessment and on the May 2003 Wells G&H Superfund Site OU-3 Aberjona River Study Baseline Ecological Risk Assessment. These comments and EPA's responses are included in the Administrative Record. In addition, the Settling Parties collected an extensive amount of environmental data which was incorporated into the MSGRP RI report.

EPA has not yet notified any Potentially Responsible Parties ("PRPs") of their liability for past response costs or future response actions.

Principal Contaminants Discovered During Remedial Investigation Phase

Heavy metals are the principal contaminants of concern throughout Industri-plex OU-2, with arsenic representing the most significant metal present at elevated concentrations throughout the system. The most significant source of metals contamination is Industri-plex OU-1. The presence of buried animal waste, as well as other buried organic materials, has resulted in reducing conditions in groundwater and the release of metals to groundwater in a dissolved form. Ammonia is present primarily as a result of hide waste degradation. The reducing conditions in the groundwater also contribute to ammonia migration in groundwater. Historical releases include releases from groundwater and releases from surface water, sediment, and soil since operations began in 1853 until the protective remedial caps were completed in 1998. Although the contaminated soils have been capped with a permeable cap, they continue to impact groundwater at Industri-plex OU-1 due to the reducing conditions caused by the degradation of buried organic material and to discharge contaminants (e.g., dissolved arsenic) to the HBHA Pond, the HBHA Wetlands and the Aberjona River. Once contaminants are discharged from groundwater to the surface water bodies, sediments and surface water are impacted and the contaminants continue to be transported further downstream as part of the suspended solid load or in the dissolved state through diffusion processes. Current releases include releases from groundwater, sediment, and soil (total suspended solids) and sediment diffusion (dissolved arsenic).

Several organic contaminants were also detected in soils and groundwater in the Northern Study Area. Benzene was the most frequently detected VOC at concentrations exceeding state standards for groundwater. The highest concentrations of benzene were observed in the shallow groundwater in two areas: between the East Central Hide Pile and the South Hide Pile, and within a localized area along the eastern edge of the West Hide Pile. High concentrations of benzene were observed in the deeper groundwater extending from the southern side of Atlantic Avenue to the central portion of the HBHA Pond. In general, the overall benzene plume, extending in both the shallow and deeper groundwater, is located in the vicinity of Atlantic Avenue south to the HBHA Pond. This location is generally consistent with the findings of previous investigations conducted during the earlier Industri-plex OU-1 groundwater investigations and the 1983 RI. These plumes were found to discharge into the HBHA Pond.

In addition to the contaminants described above, these plumes also include elevated concentrations of ammonia. The ammonia is primarily generated through the biological degradation of the buried organic waste at Industri-plex OU-1 (e.g., animal hide waste). The highest concentrations of ammonia correlate with the buried animal/glue waste on Industri-plex OU-1. The reducing conditions in the groundwater contribute to the ammonia presence and migration in groundwater. The ammonia in groundwater, along with the arsenic and benzene plumes, discharge into the HBHA Pond, impacting surface water and sediments in the pond.

In addition to the above, the following activities also contributed to the downstream release of contamination:

- Historical, significant precipitation events and erosion;
- Historical disturbances, mixing, and relocation/distribution of wastes during development activities at Industri-plex OU-1;

A more detailed description of the Site history can be found in Section 1 of the MSGRP RI Report, the October 2005 Technical Memorandum, the Industri-plex Site 1986 Record of Decision, and the Wells G&H Site 1989 Record of Decision.

C. COMMUNITY PARTICIPATION

Throughout the Industri-plex Site's history, there has been a high degree of community involvement. EPA has kept the community and other interested parties apprised of Industri-plex

OU-2 activities through informational meetings, fact sheets, press releases and public meetings. Below is a brief chronology of recent public outreach efforts.

- December 27, 2001: EPA Meeting with Woburn Officials at Mayor's office regarding Industri-plex OU-2 and Wells G&H OU-3 merger.

- Spring 2002: EPA released a Fact Sheet and Press Release announcing the merger of the Industri-plex OU-2 with Wells G&H OU-3 to establish one comprehensive cleanup decision for the river and associated wetlands.

- June 4, 2002: EPA meeting with Woburn Residence Environmental Network (WREN) at a private residence regarding Industri-plex OU-2 and Wells G&H OU-3 investigations.

- June 19, 2002: EPA meeting with Woburn Neighborhood Association (WNA) to discuss Industri-plex OU-2 and Wells G&H OU-3 merger at Altavesta Elementary School, Woburn, MA.

- July 15, 2002: EPA meeting with Woburn City Council at the Woburn City Hall regarding Industri-plex OU-2 and Wells G&H OU-3 investigations. At the meeting, EPA provided the Woburn City Council information regarding EPA's Technical Outreach Services for Communities (TOSC) program which provides free access to independent scientific and technical assistance for the evaluation of technical documents.

- August 6, 2002: EPA meeting with Mystic River Watershed Association and Friends of Upper Mystic Lakes at a private residence regarding Industri-plex OU-2 and Wells G&H OU-3 investigations.

- March 2003: EPA released Wells G&H OU-3 Aberjona River Study Draft Baseline Human Health Risk Assessment.

- Spring 2003: EPA released a Fact Sheet and Press Release summarizing the results of the Wells G&H OU-3 Aberjona River Study Draft Baseline Human Health Risk Assessment, dated March 2003.

- April 15, 2003: EPA meeting with City officials presenting the results of the Wells G&H OU-3 Aberjona River Study Draft Baseline Human Health Risk Assessment at City Hall, Woburn, MA.

- May 6, 2003: EPA meeting with Aberjona Study Coalition (ASC) presenting the results of the Wells G&H OU-3 Aberjona River Study Draft Baseline Human Health Risk Assessment at Thompson Library, Woburn, MA.

- May 13, 2003: EPA held an informational Public Meeting presenting the results of the Wells G&H OU-3 Aberjona River Study Draft Baseline Human Health Risk Assessment at the Shamrock Elementary School, Woburn, MA.

- May 19, 2003: EPA meeting with Woburn City Council discussing the results of the Wells G&H OU-3 Aberjona River Study Draft Baseline Human Health Risk Assessment at City Hall.

- May 2003: EPA released Wells G&H OU-3 Aberjona River Study Draft Baseline Ecological Risk Assessment.

- June 2, 2003: EPA meeting with Winchester Selectman discussing the results of the Wells G&H OU-3 Aberjona River Study Draft Baseline Human Health Risk Assessment at Town Hall.

- June 16, 2003: EPA awarded $100,000 Technical Assistant Grant to the Aberjona Study Coalition (ASC) for the Industri-plex and Wells G&H Superfund Sites.

- June 2003: EPA released a Fact Sheet and Press Release summarizing the Wells G&H OU-3 Aberjona River Study Draft Baseline Ecological Risk Assessment, dated May 2003.

- July 23, 2003: EPA meeting with Aberjona Study Coalition (ASC) discussing the results of the Wells G&H OU-3 Aberjona River Study Draft Baseline Ecological Risk Assessment at Thompson Library, Woburn, MA.

- July 24, 2003: EPA meeting with Winchester Officials regarding the results of the Wells G&H OU-3 Aberjona River Study Draft Baseline Human Health Risk Assessment at Town Hall.

- July 24, 2003: EPA held an informational Public Meeting presenting the results of the Wells G&H OU-3 Aberjona River Study Draft Baseline Ecological Risk Assessment at the Shamrock Elementary School, Woburn, MA.

- Fall 2003: EPA received public comments on EPA's March 2003 and May 2003 Wells G&H OU-3, Aberjona River Study, Draft Baseline Human Health and Ecological Risk Assessments from a number of stakeholders.

- June 28, 2004: EPA released comprehensive responses to public comments received on the Wells G&H OU-3, Aberjona River Study, March 2003 and May 2003 Draft Baseline

Human Health and Ecological Risk Assessments.

- September 2004: EPA released Revised Wells G&H OU-3 Aberjona River Study Baseline Human Health and Ecological Risk Assessment, dated September 2004, based upon the Agency's June 28, 2004 responses to public comments.

- October 2004: EPA released a Fact Sheet and Press Release summarizing the Revised Wells G&H OU-3 Aberjona River Study Baseline Human Health and Ecological Risk Assessment, dated September 2004, based upon the Agency's June 28, 2004 responses to public comments.

- March 2005: EPA released Industri-plex Superfund Site OU-2 (and including Wells G&H Superfund Site OU-3, Aberjona River Study) Comprehensive Multiple Source Groundwater Response Plan (MSGRP) Remedial Investigation Report.

- April 2005: EPA released a Fact Sheet summarizing the March 2005 Industri-plex Superfund Site OU-2 (and including Wells G&H Superfund Site OU-3, Aberjona River Study) Comprehensive Multiple Source Groundwater Response Plan (MSGRP) Remedial Investigation Report. The Fact Sheet identified the next steps in the schedule as the release of a Proposed Plan in May 2005 or June 2005 which would begin a 30-day public comment period.

- April 15, 2005: EPA released a Press Release announcing EPA's informational Public Meeting scheduled for 7:00 PM, April 28, 2005, at the Shamrock Elementary School, Woburn, MA to discuss the results of the Industri-plex Superfund Site OU-2 (and including Wells G&H Superfund Site OU-3 Aberjona River Study) MSGRP RI report.

- April 28, 2005: EPA held an informational Public Meeting presenting the results of the Industri-plex Superfund Site OU-2 (and including Wells G&H Superfund Site OU-3, Aberjona River Study) comprehensive MSGRP RI report. EPA also announces that a Proposed Plan would be released in May 2005 or June 2005 beginning a 30-day public comment period.

- June 17, 2005: EPA released Press Release announcing June 30, 2005 informational Public Meeting of Proposed Plan for Industri-plex Superfund Site OU-2 (and including Wells G&H Superfund Site OU-3, Aberjona River Study) at the Shamrock Elementary School, Woburn, MA.

- June 28, 2005: EPA published a legal notice and brief analysis of the Proposed Plan in the Woburn Daily Times Chronicle.

- June 30, 2005: EPA released the Industri-plex Superfund Site OU-2 (and including Wells G&H Superfund Site OU-3, Aberjona River Study) Feasibility Study ("MSGRP FS").

- June 30, 2005: EPA released the Industri-plex Superfund Site OU-2 (and including Wells G&H Superfund Site OU-3, Aberjona River Study) Proposed Plan with the 30-day comment period beginning on July 1, 2005, and ending on July 31, 2005.

- June 30, 2005: EPA held an informational Public Meeting presenting the results of the Industri-plex Superfund Site OU-2 (and including Wells G&H Superfund Site OU-3, Aberjona River Study) MSGRP FS and Proposed Plan, and initiates a 30-day public comment period beginning July 1, 2005 and ending July 31, 2005. EPA makes the administrative record available for public review at EPA's offices in Boston, and Woburn Public Library. This is the primary information repository for local residents and will be kept up to date by EPA. In addition, administrative record was made available at the Winchester Public Library, and copies of the administrative record on compact discs were distributed to the public that attend the informational Public Meeting.

- July 15, 2005: EPA Press Release announcing 30-day extension to the 30-day comment period, based upon a request from a community group, with the comment period ending on August 31, 2005.

- July 27, 2005: EPA Public Hearing recording formal verbal public comments on the Industri-plex Superfund Site OU-2 (and including Wells G&H Superfund Site OU-3 Aberjona River Study) Proposed Plan, dated June 2005.

- October 19, 2005: After reviewing public comments received by August 31, 2005, EPA releases Technical Memorandum – Evaluation of Ammonia and Supplemental Soil Data, Fact Sheet supplementing the June 2005 Proposed Plan, and Supplemental Administrative Record, and re-opens the public comment period from October 20, 2005 to November 18, 2005.

- November 17, 2005: EPA second Public Hearing recording formal verbal comments on the Industri-plex Superfund Site OU-2 (and including Wells G&H Superfund Site OU-3 Aberjona River Study) June 2005 Proposed Plan, October 2005 Technical Memorandum – Evaluation of Ammonia and Supplemental Soil Data, and October 2005 Fact Sheet supplementing the June 2005 Proposed Plan.

D. SCOPE AND ROLE OF OPERABLE UNIT OR RESPONSE ACTION

As with many Superfund sites, the problems at the Industri-plex Superfund Site are complex. EPA has organized the work into two operable units (OUs). Furthermore, considering the hydraulic connection and similar contaminants of concerns (e.g., metals such as arsenic) at Industri-plex OU-1 and downstream low-lying areas along the Aberjona River and associated wetlands, Industri-plex OU-2 incorporates the downstream investigations associated with the Wells G&H Superfund Site OU-3 Aberjona River Study (known as the Southern Study Area for river reaches 1 – 6) as depicted on Figure A-4.

In 1986, EPA signed a Record of Decision for the first phase of cleanup at Industri-plex OU-1 which included the following:

- construction of permeable protective caps over more than 100 acres of soils contaminated with heavy metals (e.g., arsenic, lead, chromium) and animal wastes to prevent people from coming into contact with the contamination;

- construction of an impermeable protective cap, gas (hydrogen sulfide) collection and treatment system over approximately 5 acres;

- establish institutional controls to preserve the continued effectiveness of the Industri-plex OU-1 remedy to protect human health and the environment;

- implement an interim groundwater remedy for groundwater hot spots of benzene and toluene contamination; and

- conduct further investigations (known as the Groundwater/Surface Water Investigation Plan or "GSIP") of site-related contamination at and downstream of Industri-plex OU-1 to support a second operable unit.

The permeable protective caps, impermeable protective cap, and gas collection and treatment system were completed in 1998, though cap certification reports have not yet been completed for Industri-plex OU-1. The Final GSIP investigations were completed between 2002 and 2004. The final design of the institutional controls was completed in March 2005, though the institutional controls have not yet been recorded on the properties at Industri-plex OU-1. The Industri-plex OU-1 Settling Parties did not implement the interim groundwater remedy; hence, EPA will not be issuing a certification of completion for the interim groundwater remedy portion of Industri-plex OU-1, and the permanent groundwater remedy outlined in this ROD supersedes the interim groundwater remedy component of OU-1. During the 1990s and early 2000s, portions of Industri-plex OU-1 were redeveloped and currently house retail, commercial and light industry, as well as an intermodal transportation facility, the Anderson Regional Transportation Center.

In addition, the 1986 ROD required EPA to conduct further investigations, called the Multiple Source Groundwater Response Plan (MSGRP), to support a second operable unit. This investigation serves as the basis for this ROD.

Industri-plex OU-2: This ROD incorporates the current knowledge of the nature and extent of contamination, contaminant fate and transport mechanisms, and baseline risk assessment results as presented in the MSGRP RI report, the October 2005 Technical Memorandum, and the Administrative Record. This ROD establishes a final groundwater remedy for the Industri-plex Site, where the Commonwealth has determined the aquifer is of low use and value (i.e., not for drinking water purposes) at Industri-plex OU-1 north of Interstate 95 within the Northern Study Area. If any final groundwater decisions are necessary for the remaining Wells G&H aquifer within the Southern Study Area, which the Commonwealth determined to be a medium use and value aquifer with the potential to be used as a future drinking water source, then these decisions will be made in the Wells G&H Superfund Site Operable Unit 2, Central Area Aquifer Study.

This ROD addresses the contamination originating from Industri-plex OU-1 and downstream migration of contamination from groundwater contaminant discharges from Industri-plex OU-1. The waste capped under Industri-plex OU-1 continues to serve as a principal threat through the release of contaminants in groundwater. Ingestion of, dermal contact with, and inhalation of volatile compounds released from extracted groundwater within this aquifer poses a potential future risk to human health because EPA's acceptable risk range is exceeded. This ROD also addresses the contamination of soils and sediments. Ingestion of and dermal contact with these soils and sediments poses a potential current and/or future risk to humans because EPA's acceptable risk range is exceeded. Exposure to these sediments also poses an unacceptable ecological risk to the benthic community. Finally, this ROD addresses the contamination of surface water. Exposure to these surface waters poses an unacceptable ecological risk to aquatic life.

This ROD represents the final response action for the Industri-plex Site and addresses the principal threats at Industri-plex OU-2 through interception, treatment and sequestration of contaminated groundwater plumes at the northern portion of the HBHA Pond (primary and secondary treatment cells) and the West Hide Pile (enhanced in-situ bioremediation), periodic removal of sediments accumulating at the northern portion of the HBHA Pond, sediment removal and restoration at the southern portion of the HBHA Pond and near shore sediment areas, capping (impermeable) stream channels impacted by contaminated groundwater plumes discharge (including New Boston Street Drainway), capping contaminated soils adjacent to the HBHA Pond (including Area A6), establishing institutional controls for groundwater, soils, and sediments to prevent exposures to contamination above cleanup standards (outlined in Section L of this ROD) and protect the remedy, compensation for any wetland function and value losses nearby in the watershed, and long-term monitoring of groundwater, surface water, and sediments.

The ROD will serve as the final groundwater, soils, surface water and sediment remedy at the Industri-plex Site.

The principal and low-level threats that this ROD addresses are summarized in the following table:

Principal Threats	**Medium**	**Contaminant(s)**	**Action To Be Taken**
Future Human Health Risk	Groundwater	Arsenic, VOCs, and ammonia	Management of migration and institutional controls
Future Human Health Risk	Soil	Arsenic	Institutional Controls
Current/Future Human Health Risk	Sediment	Arsenic, benzo(a)pyrene	Removal, off-site disposal, and institutional controls
Ecological Risk	Sediment	Arsenic	Partial removal, capping, and management of migration, and compensatory mitigation for wetland and stream losses
Ecological Risk	Surface water	Arsenic, benzene, and ammonia	Management of migration, and compensatory mitigation for wetland and stream losses

E. SITE CHARACTERISTICS

Chapter 1 of the June 2005 MSGRP FS contains an overview of the MSGRP RI. The significant findings of the March 2005 MSGRP RI and October 2005 Technical Memorandum are summarized below. These technical documents can be found in the Administrative Record and contain various figures illustrating the locations of samples collected during the investigation, and media concentrations/detections.

The approximate boundaries of Industri-plex OU-2 are illustrated on Figure A-3, which accounts for fate and transport processes and/or depositional locations where contamination contributes to human health or environmental risks. The Aberjona River flows through the Industri-plex OU-2, and the HBHA is located in the northwest portion of the Industri-plex OU-2 contributing surface water flow to the Aberjona River. Several associated tributaries, drainways, and wetlands also traverse or are situated within Industri-plex OU-2. The Industri-plex OU-2 originates at the Industri-plex OU-1, which is the location of the only significant source of contamination in Industri-plex OU-2.

The disposal of manufacturing wastes at Industri-plex OU-1 from 1853 to 1968 and development activities from 1968 to the early 1970s resulted in the filling of wetlands, diverting the course of the Aberjona River, and the creation of four large waste stockpiles. The Halls Brook Holding Area (HBHA) was created as a storm water management area following the filling of Mishawum Lake in the early 1970s. The northern portion of the HBHA consists of a large rectangular shallow pond (approximately 175 feet by 900 feet and depth up to 20 feet), referred to as the HBHA Pond. Downstream of the HBHA Pond, the southern portion of the HBHA consists of wetlands containing three smaller ponds, referred to as the HBHA Wetland. When the HBHA was constructed, the Aberjona River was diverted from Mishawum Lake to its current course which follows a series of culverts and drainage channels in the middle of the Commerce Way roadway and runs parallel to the HBHA approximately 1,500 feet to the east. Flows from the Aberjona River and the HBHA converge at the outlet of the HBHA at Mishawum Road. The Aberjona River continues to flow south through the Wells G&H Superfund Site wetland north of Salem Street (referred to as the Wells G&H Wetland), and the Cranberry Bog Conservation Area south of Salem Street. The river continues to flow south through southern Woburn and Winchester, and concludes at the Mystic Lakes.

In 1986, EPA completed a Record of Decision (ROD) for Industri-plex OU-1 that selected a soil remedy which consisted of capping arsenic/lead/chromium contaminated soils and animal hide wastes material piles (i.e., East Hide Pile, East Central Hide Pile, West Hide Pile, South Hide Pile, and portions of the NSTAR (Formerly Boston Edison Company) right-of-way Number 9. These soils represent the most significant source of contamination at the Industri-plex OU-2. The contaminants gradually dispersed into the surrounding environmental media and have resulted in the contamination of soil, groundwater, surface water, sediments, and biota at the Industri-plex OU-2. The nature and extent of the contamination along with fate and transport information are summarized in the following sections.

Soil Contamination

The nature and extent of soil contamination was further investigated in areas within, adjacent to, and downgradient of Industri-plex OU-1. These areas included soils along the perimeter of the Industri-plex OU-1 boundary, buried sediments of the former Mishawum Lake bed, benzene and toluene source area soils, and floodplain soils along the HBHA and the Aberjona River. Soils impacted by site-related contaminants are as follows:

- Within the boundaries of Industri-plex OU-1, there are over 150 acres of soils contaminated with heavy metals (specifically, arsenic, lead, chromium, and, to a lesser degree, barium, copper, zinc, and mercury) and animal hide waste materials. Approximately 110 acres exceeded the heavy metals threshold values established in the

1986 ROD and have been capped with either an engineered cover or with existing materials considered to be "equivalent cover" (e.g., asphalt pavement, building slabs, etc.) These capped areas include animal hide waste materials buried at the West Hide Pile, East Hide Pile, East-Central Hide Pile, South Hide Pile and along portions of the NSTAR right-of-way Number 9. Although capped and no longer a threat from erosion, these contaminants remain on-site and represent the most significant source of contamination at Industri-plex OU-2. Some of these chemicals have remained adsorbed to soils while others have been mobilized into deeper soils, into groundwater, and into the adjacent wetlands, HBHA and Aberjona River.

- Four areas located outside and adjacent to the Industri-plex OU-1 boundary were investigated to determine if metals contamination exceeding the Industri-plex OU-1 soil remedy action levels extended beyond the Industri-plex OU-1 boundary. Only the area located between the southern Industri-plex OU-1 boundary and the HBHA Pond (Area 6) was found to contain concentrations of arsenic, chromium, and lead exceeding action levels established for the Industri-plex OU-1 soil remedy.

- Prior to it being filled to create open land for development, Mishawum Lake served as one of the first significant depositional areas for contaminants being discharged from Industri-plex OU-1. Soils exhibiting elevated concentrations of metals exceeding comparative regulatory criteria (i.e., EPA Region 9 Preliminary Remediation Goals (PRGs) and MassDEP Soil Background criteria) were detected in both near-surface and subsurface soils. The highest concentrations of metals and the most frequent exceedances of comparative screening criteria for metals, in particular arsenic, generally occurred in the soil samples collected at a depth representing the former lake bottom.

- An investigation was conducted to locate the source of persistent benzene and toluene groundwater contamination adjacent to the West Hide Pile (benzene) and along Atlantic Avenue (benzene and toluene) at Industri-plex OU-1. This investigation included subsurface geophysical surveys (i.e., ground penetrating radar and electro-magnetic surveys), soil-gas sampling, subsurface soil samples, and groundwater sampling. Although a concentrated source of contamination was not located (e.g., Underground Storage Tanks (UST), drums, etc.), both benzene and toluene were detected in most soil samples. However, these detections were generally low with the majority of samples well below the comparative screening criteria. At sample locations collected along Atlantic Avenue, 4 of 17 samples exceeded the screening criterion for benzene (600 micrograms per kilogram [μg/kg]) and none exceeded the screening criterion for toluene (520,000 μg/kg). In addition, one soil sample collected at the West Hide Pile within the saturated zone, exhibited elevated concentrations of benzene (210,000 μg/kg) exceeding its screening criterion. While toluene and benzene persist in these areas, only benzene exceeded its screening criterion.

- Soil samples were collected in depositional areas along the HBHA and the Aberjona River in order to investigate the presence of heavy metals deposited by floodwaters. Areas investigated included the banks of a drainage channel along/adjacent to the NSTAR right-of-way Number 9 in the southern portion of Industri-plex OU-1, floodplain areas along the eastern and southwestern banks of the HBHA, wetlands by Normac Road (south of Interstate 95 and north of the Wells G&H Wetland), the backyard of a residence located on Salem Street at the southwest edge of the Wells G&H Wetland, the Cranberry Bog Conservation Area, Danielson Park, river bank/wetland areas at Kraft Foods, Davidson Park in Winchester, and the banks of the Aberjona River near the Wedgemere train station in Winchester. Arsenic was the only metal that was detected in all floodplain sample locations at concentrations ranging from 6.1 milligrams per kilogram (mg/kg) to 272 mg/kg. Arsenic concentrations exceeded the screening criterion in all areas (except at the Wedgemere station where the criterion was exceeded in seven of nine samples). Although the screening criterion for arsenic (0.39 mg/kg) is based on residential assumptions, approximately 87 percent of floodplain soil samples exhibited arsenic concentrations that also exceeded the MassDEP Natural Soil Background reference criterion (20 mg/kg).

Groundwater Contamination

Between 1990 and 2002, over 460 groundwater samples were collected, analyzed and quantitatively evaluated to assess area-wide groundwater contamination in the Northern Study Area. Groundwater within the Southern Study Area is scheduled for comprehensive evaluation by EPA as part of the Wells G&H Superfund Site Operable Unit 2, Central Area Aquifer, investigations. The findings of the Northern Study Area investigation are as follows:

- Arsenic was more frequently detected in groundwater than any other metal (i.e., detected in 360 samples out of 467 samples analyzed for metals). Approximately 12 percent of the samples exceeded the arsenic screening criterion of 400 micrograms per liter (μg/L). Arsenic concentrations were generally highest in the groundwater south and west of the East Central Hide Pile and beneath the NSTAR right-of-way, with the maximum observed concentration of 24,400 μg/L located in the NSTAR right-of-way, just northwest of the HBHA.

- Other metals that exceeded the screening criteria included:

    - cadmium: only exceeded in three samples; the highest only slightly exceeding the criterion was located just north of the East Central Hide Pile;

- chromium: only exceeded in two samples collected from the same well located approximately 450 feet south of Atlantic Avenue (likely attributable to high suspended solids in the sample);

- lead: exceeded in 23 samples; all located in the areas north of the HBHA Pond, east of New Boston Road, and west of Atlantic Avenue;

- mercury: exceeded in eight samples sporadically distributed throughout the study area, but the highest concentrations observed were just northwest of the HBHA;

- nickel: exceeded in five samples sporadically distributed throughout the study area but the highest concentrations observed in the area between the East Hide Pile and the East Central Hide Pile; and

- zinc: exceeded in 11 samples sporadically distributed through out the study area but the highest concentration observed in the area of the Anderson Regional Transportation Center.

- Benzene was the most frequently detected VOC at concentrations exceeding the screening criteria. In the shallow groundwater, the highest concentrations of benzene were observed in two areas: between the East Central Hide Pile and the South Hide Pile adjacent to Atlantic Avenue (69,000 μg/L); and within a localized area along the eastern edge of the West Hide Pile (4,100 μg/L). In the deeper groundwater, high concentrations of benzene extended from the southern side of Atlantic Avenue to the southern end of the HBHA Pond. In general, the overall benzene plume, extending in both the shallow and deeper groundwater, is located in the vicinity of Atlantic Avenue south to the HBHA Pond. This current location is generally consistent with the findings of previous investigations conducted during the early GSIP investigations and the 1983 RI.

- Elevated concentrations of ammonia exist in contaminated groundwater plumes at Industri-plex OU-1. The decomposition of the buried animal hide wastes contribute significantly to the generation and release of ammonia in groundwater. In addition, the contaminated groundwater plumes contain strong reducing conditions which contribute to the presence and migration of high ammonia concentrations in the groundwater and its discharge into the HBHA Pond. The fate and transport of ammonia is similar to the fate and transport patterns observed for dissolved arsenic groundwater plumes. The highest concentrations of ammonia in groundwater (up to 2,710 milligrams per liter (mg/L)) were found at locations adjacent to or downgradient of the existing animal hide piles and in other areas where animal wastes have been buried, such as the NSTAR right-of-way (2,370 mg/L) and the West Hide Pile (63.7 mg/L). Consistent with the MSGRP RI, these groundwater plumes, including ammonia, migrate and discharge in the HBHA Pond.

- Although toluene concentrations did not exceed the screening criteria in samples collected during the recent investigations, toluene was detected at elevated concentrations within the center of the plume, just south of the Atlantic Avenue/Commerce Way intersection. Elevated concentrations of toluene (up to 2,500 µg/L) were observed in this area. During previous investigations conducted in 1997 by the ISRT as part of the source area investigation, elevated concentrations of toluene were also detected in this area with a maximum observed concentration of 19,000 µg/L. Elevated concentrations were also detected within the intermediate and deeper overburden beneath and immediately south of the NSTAR right-of-way.

- Trichloroethene (TCE) was observed sporadically in shallow groundwater samples in the vicinity of the NSTAR right-of way and the HBHA Pond. TCE in the shallow groundwater surrounding the HBHA Pond was detected at below screening criteria (< 6 µg/L).

- TCE was also detected at higher concentrations (up to 110 µg/L) in the intermediate to deep overburden in another area approximately one-half mile south of Industri-plex OU-1, south and southwest of Cabot Road, in the vicinity of former Mishawum Lake. TCE degradation by-products (1,1-dichloroethene, cis-1,2-dichlorethene) were also detected, but concentrations did not exceed their respective screening criteria. Based on the available groundwater data, it appears that the source of the TCE along Cabot Road is not related to Industri-plex OU-2 and appears to be isolated. This TCE, located south and southwest of Cabot Road in the vicinity of former Mishawum Lake, will not be addressed as part of this ROD.

- Although detected naphthalene concentrations did not exceed screening criteria, elevated concentrations were observed in shallow groundwater adjacent to and north of the HBHA Pond.

- Samples collected from varying depths at 10 boring locations along the southern perimeter of the Northern Study Area are considered representative of groundwater quality as it leaves the Northern Study Area and enters the Wells G&H aquifer Interim Wellhead Protection Area. These samples were compared to Massachusetts Maximum Contaminant Levels (MMCLs) and MassDEP GW-1 standards. Of the metals detected, only arsenic exceeded its MMCL (10 µg/L). No organic compounds were found to exceed their respective MMCLs or GW-1 standards.

Sediment Contamination

A total of 429 surface sediment samples (0-6 inches in depth) were collected from river, lake, and wetland locations from Industri-plex OU-1 to the Mystic Lakes during several GSIP and MSGRP investigations from 1995 through 2004 (see Figure A-4). In addition, sediment samples were also collected from local and regional reference stations from areas not expected to have been impacted by site-related contaminants. All sediment samples were analyzed for metals and some were also analyzed for VOCs, SVOCs, pesticides, and PCBs. Metals concentrations observed in sediments were compared to concentrations found at the reference stations and to regulatory reference criteria, such as the EPA Region 9 PRGs and the Ontario Ministry of the Environment and Energy (OMEE) Severe-Effects Level (SEL) sediment quality guidelines.

- The highest concentrations of metals and the most exceedances of reference criteria were found in the HBHA, the Wells G&H Wetland, and the Cranberry Bog Conservation Area. The number of metals exceeding reference criteria was highest in the Wells G&H Wetland, the Cranberry Bog Conservation Area, and the HBHA.

- Arsenic was the most prevalent metal that exceeded reference criteria. Other metals where more than 50 percent of the samples exceeded all the reference criteria included iron and lead.

- Twenty VOCs were detected in surface sediment samples. Most compounds were detected infrequently and at low concentrations. Only four compounds (benzene, tetrachloroethene, trichloroethene, and vinyl chloride) exceeded the EPA Region 9 PRGs for residential soil in at least one sample.

- Twenty-three SVOCs, primarily PAHs, were detected in surface sediment samples. Five PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene] exceeded Region 9 PRGs at the Industri-plex OU-2 and the reference stations.

<u>Surface Water Contamination</u>

Beginning in May 2001 and ending in October 2002, an extensive surface water monitoring program was conducted throughout the watershed that included measurements of precipitation, streamflow, suspended sediment, and metals concentrations (dissolved and total), in addition to other physio-chemical parameters at 10 stations located along a 9-mile reach of the Aberjona River. See Figure E-1 for the location of each of the surface water sampling stations. The intensive monitoring period captured monthly baseflow sample data as well as six storm events spanning multiple seasons (spring, summer, and fall).

- Concentrations of metals in surface water only sporadically exceeded National Recommended Water Quality Criteria (NRWQC) during both baseflow and stormflow conditions. The most frequently detected metals exceeding Criterion Continuous

Concentration (CCC) (chronic) criteria included aluminum, copper, lead, and zinc. Although the concentrations of arsenic were below NRWQC criteria, both dissolved and particulate phases of arsenic represent potential impacts to downstream depositional areas. For the majority of the 10 surface water sampling stations, the total arsenic concentrations were highest during stormflow conditions.

- The surface water monitoring data showed that metals transport is highly impacted by total suspended solids (TSS) concentrations. Spikes in metals concentrations are associated with spikes in TSS. Monitoring data collected during baseflow conditions show that arsenic concentrations are higher in the HBHA (including HBHA Pond and HBHA Wetlands). This trend was also observed for the other metals evaluated (chromium, copper, iron, lead, and mercury).

  The highest concentrations for metals were most often observed at the outlet of the HBHA (Station 4). Spikes in metals concentrations at this station were associated with spikes in suspended sediment concentrations indicating that elevated levels of metals at this station are associated with the particulate phase. The total metals concentrations typically decreased downstream of Station 4. During storm events, the highest arsenic concentrations were observed at the outlet of the HBHA Pond (Station 2). A chemocline is present within the HBHA Pond, which generally divides shallow water in the pond from deeper water. The chemocline is created and maintained by the continuing discharges of higher conductivity, greater density, and low oxygen content (anoxic) contaminated groundwater at the deeper portions of the HBHA Pond while the upper layer of the water column in the pond has a lower conductivity, lower density, and higher oxygen content (oxic) sustained by contributions of non-contaminated surface water from Halls Brook. The chemocline within the HBHA Pond becomes unstable during large storm events causing high contaminant concentrations in the deep surface water to mix with shallow water, and higher concentrations of arsenic to be released at the outlet of the pond. See the following fate and transport section for further information on the chemocline in the HBHA Pond.

- The highest concentration of dissolved arsenic in the HBHA Pond was observed in deep surface water at the northern multi-level sample station (5,043 μg/L). High concentrations of dissolved arsenic were also observed in deep surface water at central and south portions of the HBHA Pond with the highest values of 2,170 μg/L (central) and 2,845 μg/L (south). The concentrations of dissolved arsenic in shallow surface water at the HBHA Pond ranged from 2.0 to 27.4 μg/L.

- The reduction of metal concentrations observed during baseflow conditions between Station 4 and Station 5 and subsequent downstream stations indicates that deposition is occurring between stations. Sediment samples were collected at significant depositional areas along the HBHA and Aberjona River from Industri-plex OU-1 to the Mystic Lakes. The distribution of arsenic and other metals along the river shows a clear pattern of metals transport from Industri-plex OU-1 south to the Mystic Lakes, with the greatest area of sediment deposition occurring at the Wells G&H Wetland and Cranberry Bog Conservation Area.

- Benzene was detected in deep surface water in the northern portion of the HBHA Pond with concentrations up to 1,830 μg/L. Concentrations decreased through the water column to the point where benzene was not detected at the pond surface.

- Concentrations of ammonia up to 1,380 mg/L were observed discharging in the northern portion of the HBHA Pond, and concentrations up to 1,270 mg/L were observed in the deep surface water of the HBHA Pond. The concentrations of ammonia in the shallow surface water at the HBHA Pond outlet were slightly elevated and ranged from 4.0 mg/L to 17.9 mg/L.

<u>Fate and Transport of Key Contaminants</u>

Past storage, manufacture, handling and disposal practices of numerous chemicals at Industri-plex OU-1 has resulted in the release to soils of VOCs (aromatic hydrocarbons), SVOCs (including PAHs), and metals. Depending on the combination of contaminants, geologic and hydrogeologic conditions, and surface features, contaminants released to soils have migrated into other environmental media, specifically the underlying groundwater, adjacent surface water bodies, and sediments.

The fate and transport of contaminants involve complicated and interdependent processes that affect the mobilization of contaminants between various media and areas. The principal source of contamination within Industri-plex OU-2 is the capped soils underlying Industri-plex OU-1. These contaminated soils are impacting groundwater, which in turn discharges to the HBHA Pond and wetlands and northern portions of the Aberjona River, subsequently impacting surface water and sediment. The surface water flows from the HBHA and Aberjona River combine at Mishawum Road and represents the primary contaminant transport vehicle for downgradient receptors. While the applicable fate and transport processes are generally the same throughout the MSGRP RI Study Area, the impacted media and contaminants of concern vary from the northern portions of Industri-plex OU-2 to the lower portions of Industri-plex OU-2 and are summarized as follows:

FATE & TRANSPORT MODEL AREA	IMPACTED MEDIA	CONTAMINANTS OF CONCERN
Industri-plex OU-1 and the HBHA	Soils, Groundwater, Sediment, Surface water	Metals, VOCs , SVOCs, Ammonia
Wells G&H Wetland	Sediment, Surface water, Groundwater	Metals, SVOCs
Cranberry Bog Conservation Area	Sediment, Surface water	Metals

- The most significant ongoing transport process for metals in soils underlying Industri-plex OU-1 is leaching to groundwater. Once in groundwater, contaminants continue to migrate. The contaminants most widely detected in groundwater include arsenic, benzene, toluene, ammonia and to a lesser degree, lead and zinc. Contaminants are then transported through groundwater flow paths where they predominantly discharge in the northern portions of the HBHA Pond and migrate downstream impacting sediments and surface water.

- Portions of groundwater at greater depths continues to flow parallel to the main buried valley situated approximately between the MBTA rights-of-way rail road tracks (Lowell Commuter Line) and Commerce Way (See MSGRP RI Figure 3-2). As evidenced by downgradient groundwater sample data, the deeper portion of the aquifer does not appear to be a significant pathway for contaminant migration as contaminant concentrations in deeper groundwater are not being sustained. These contaminants are likely being attenuated by biological and chemical processes.

- Available data indicate that the biological activity occurring primarily from the degradation of buried animal hide waste materials, as well as soils contaminated with aromatic hydrocarbons [benzene and toluene], help produce a reducing environment in groundwater. The abundance of buried animal hide waste at Industri-plex OU-1 significantly contributes to these reducing conditions. In turn, metals, such as arsenic and iron, are being reduced, rendered more soluble, and therefore much more mobile in groundwater. These actions are evidenced by observed groundwater arsenic levels as well as the presence of arsenic in surface water samples collected in the groundwater discharge zones in the HBHA Pond. Also, as discussed below, the reducing conditions assist in the migration of ammonia.

- A fraction of the dissolved arsenic being discharged from groundwater into the HBHA Pond sediments becomes bound to ferric oxides and is effectively removed from the water column and becomes part of the sediment load in the pond. However, a portion of the sediment-bound arsenic is released and migrates through the sediments up into the water column. This arsenic can either be further sequestered from solution or transported downstream. These reactions are dependent upon a fairly stable chemocline that is present at about the mid-water depth.

- The chemocline is the result of the difference in density between oxic surface water and anoxic contaminated groundwater and steady inputs of oxygen, iron, sulfates, and organic carbon. The Halls Brook influent provides steady inputs of oxygen and organic carbon solids, while contaminated groundwater plumes provide steady inputs of iron and sulfates. The relative position of the chemocline fluctuates throughout the year due to seasonal variations in temperature and surface water flow. Below the chemocline in deep surface water, high concentrations of dissolved arsenic (up to 5,043 μg/L), benzene (up to 2,530 μg/L), ammonia (up to 1,270 mg/L) are present in the HBHA Pond. Sudden increases in flows, as seen during storm conditions, mix the water column and destabilize the chemocline thus allowing more arsenic to be "flushed" downstream. However, after such storm events, the chemocline has been shown to be re-established within a period of less than a month.

- Once in the surface water column, as either dissolved or associated with the suspended solid load, arsenic will continue to migrate downstream with the flow of water. Depending on the geochemical and flow conditions, dissolved metals in the water column may adsorb to suspended solids, such as fine grained soil particles or other metal complexes and either settle out and become part of the sediment bed load or be transported within the water column as part of the suspended solid load and be deposited at locations downstream.

- As part of the sediment bed load and depending on the geochemical conditions, metals may dissolve from the sediment particles back into the surface water, whereby the cycle of dissolution and precipitation would continue. This cycling was mostly observed within portions of the HBHA that exhibited significant anoxic/reduced conditions, specifically, within the HBHA Pond. However, this cycling may be occurring at other portions of the HBHA, but likely at a lesser degree than the HBHA Pond due to its geometry and influx of anoxic groundwater.

- Organic compounds in groundwater, such as benzene, discharging into the sediment and deeper portions of the HBHA Pond are generally attenuating to very low concentrations or are not detected in shallow portions of the HBHA Pond surface water. The VOCs in sediments may be biodegraded, partitioned to surface water, or remain bound to the organic matter present in stream sediments. VOCs that enter into surface water can volatilize into the ambient air where they are degraded by photolysis or hydrolysis; they can remain in surface water and undergo degradation processes such as biodegradation, hydrolysis, or reduction-oxidation reactions; or they can become attenuated through dilution, diffusion, and advection. A study conducted by Massachusetts Institute of Technology (MIT) in 2000 concluded that biodegradation at the anoxic/oxic interface was the largest sink for benzene in the HBHA Pond as compared to other fate and transport processes.

- Industri-plex OU-1 has a very large source of organic nitrogen in the form of buried animal hide wastes. As bacteria decompose the waste, some of the nitrogen that was bound up in complex organic molecules can be released to the soil as ammonia. Through leaching processes, the ammonia is converted to ammonium by reacting with water. Ammonia exists in water in two forms: as ammonium ion (NH^{4+}), which is highly soluble, and as ammonia gas (NH_3). In aerobic settings, organic nitrogen may mineralize to ammonium, which plants and microbes can utilize, adsorb to negatively charged particles (e.g., clay), or diffuse to the surface. Ammonium can be absorbed by plants or microbes and incorporated back into the organic matter matrices. It can also become bound to organic soil matrices since the soils have negative charges and the ammonium is positive. However, ammonium is a reduced compound, so if there is no oxygen present, it will not transform or be converted to a more soluble form. Under these reduced conditions, ammonium will be transported conservatively through the aquifer. In the case of Industri-plex OU-2, reduced groundwater conditions have been documented at Industri-plex OU-1 south to Interstate 95 within the Northern Study Area (MSGRP, 2005a). These reduced and anoxic groundwater conditions at Industri-plex OU-2 allow the ammonium to remain in groundwater (up to 2,710 mg/L), migrate with the groundwater flow towards the south, and discharge into the HBHA Pond.

  High concentrations of ammonia, as part of the contaminated groundwater plumes from Industri-plex OU-1, are discharged into HBHA Pond resulting in high concentrations of ammonia in surface water. The presence of the chemocline in the HBHA Pond helps sequester the highest ammonia concentrations at depth (up to 1,762 mg/L) by limiting vertical transport and assisting natural processes available to convert some of the ammonia to nitrates, nitrites, and nitrogen gas. As ammonia migrates to the chemocline, aerobic bacteria can convert the ammonia to nitrite. Through diffusion, the nitrite comes into contact with the more oxygenated zone of the chemocline where it can be partially oxidized to nitrate. Further reductions can also occur through facultative anaerobic bacteria where the nitrate can be reduced to nitrite and nitrogen gas can be released. The shallow surface water (0 – 100 cm) ammonia concentrations were elevated up to 31.1

mg/L. Hence, as described earlier, the chemocline within the HBHA Pond helps keep high concentrations of contaminants, including ammonia, below the chemocline in deeper surface water.

Elevated ammonia concentrations ranging from 10.0 to 12.7 mg/L in upgradient surface water tributaries (East Drainage Ditch, Landfill Creek, and New Boston Street Drainway) also contribute to elevated ammonia surface water concentrations at the outlet of Halls Brook prior to its discharge into HBHA Pond and shallow surface water in HBHA Pond. Halls Brook, upgradient of its confluence with these tributaries, did not exhibit detectable surface water ammonia concentrations and serves to dilute ammonia surface water concentrations from these upgradient tributaries. In addition, elevated levels of ammonia were detected at the NSTAR (formerly Boston Edison Company (BECO)) right-of-way culvert discharging into the HBHA Pond. These elevated levels of ammonia also contribute to ammonia concentrations in shallow surface water in HBHA Pond. However, the contribution of ammonia from these surface water discharges is much less significant than the ammonia concentrations in deep surface water of the HBHA Pond, which originate from the Industri-plex OU-1 contaminated groundwater plumes discharging into the pond.

- Due to its proximity to the Lower South Pond and wetlands, groundwater along the eastern edge of the West Hide Pile, where another source of benzene was detected, is likely discharging to the surface water of the adjacent pond and wetland areas as evidenced by the absence of benzene in groundwater samples downgradient of the West Hide Pile. In addition, similar to groundwater conditions at other areas of Industri-plex OU-1 with buried animal waste materials, the groundwater conditions at the West Hide Pile and possibly the East Hide Pile (see Figure J-4), likely produce elevated levels of ammonia and arsenic in groundwater as evidenced by groundwater sampling location A02-1 at the West Hide Pile which contained elevated ammonia and arsenic concentrations of 79.3 mg/L (October 2005 Technical Memorandum, Appendix A) and 362 ug/L (March 2005 MSGRP RI Report, Appendix 2D), respectively. Once discharged to the sediments and surface water, the benzene is likely being attenuated by biodegradation, chemical degradation, volatilization, and dispersion as seen in the HBHA Pond. No sediment or surface water data were collected in this area to evaluate potential groundwater impacts on the adjacent wetlands. Additional pre-design investigations will be carried out to determine these potential impacts, prior to implementing the West Hide Pile groundwater component of the selected remedy (i.e., In-situ Enhanced Bioremediation).

- Surface water data collected from Halls Brook indicate that during storm events, slightly elevated concentrations of chromium and lead are also flowing into the HBHA Pond. However, only lead exceeded its NRWQC CCC (i.e., chronic) criterion (2.5 μg/L) during both storm event and baseflow conditions. The source for this contamination is likely the New Boston Street Drainway and the East Drainage Ditch based on surface water quality samples collected during construction of the Industri-plex OU-1 remedy and sediment data collected during this investigation. Historically, Olin Chemical Corporation (Olin) has been identified as a source of ammonia, chromium, and N-nitrosodimethylamine (NDMA) in groundwater and chromium in sediments and soils. The Olin site is a potential source of chromium contamination in sediments and ammonia in surface water along the East Drainage Ditch, a small tributary to Halls Brook.

- Based on the surface water data, surface water clearly is the transport mechanism that is facilitating the transport of arsenic (and other metals) through the river system downstream of Industri-plex OU-1. This fate and transport mechanism is demonstrated by the baseflow and stormflow surface water sample data collected during the 18-month investigation and is also evidenced by sediment data collected throughout the Aberjona River. Based on these data, the highest concentrations of arsenic are within Industri-plex OU-2 and steadily decrease as the river flows south to the Mystic Lakes. The highest concentrations of arsenic at Industri-plex OU-2 were found at the HBHA with the highest storm flow concentrations observed at HBHA Pond outlet (MSGRP RI surface water Station 2) and highest baseflow observed at HBHA Wetland outlet (MSGRP RI surface water Station 4). Concentrations of arsenic and other metals in surface water at the furthest downstream monitoring stations, located at the Mystic Lakes, show further reductions in metals concentrations, as well as TSS concentrations, during both baseflow and stormflow conditions.

Conceptual Site Model

The Conceptual Site Model (CSM) for soil, groundwater, sediments, and surface water at Industri-plex OU-2 is provided in Figure E-2. The CSM is a three-dimensional "picture" of Industri-plex OU-2 conditions that illustrates contaminant sources, release mechanisms, exposure pathways, migration routes, and potential human and ecological receptors. It documents current and potential future Industri-plex OU-2 conditions and shows what is known about human and environmental exposure through contaminant release and migration to potential receptors. The risk assessment and response action for the soil, groundwater, sediments, and surface water at Industri-plex OU-2 is based on this CSM.

F. CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

Various types of land use are found at Industri-plex OU-2. Predominant physical features include highways, streets, paved areas, commercial and industrial properties, and open space. Residential properties are found adjacent to and in surrounding areas in close proximity to the Southern Study Area. Significant development has occurred throughout the MSGRP RI Study

Area. Development and land use in the Northern and the Southern Study Areas are discussed briefly below and in greater detail in the MSGRP RI.

1. Land Use

Current land use in Woburn is mixed, including residential, industrial, and commercial uses, with the majority of the area, including nearly all land immediately surrounding Industri-plex OU-1, developed for industrial and commercial use. Portions of the developed areas not covered by paving or buildings are landscaped and maintained. Land use in areas immediately surrounding the Aberjona River and associated floodplains and wetlands is highly urbanized and includes residential, business, light commercial, and industrial areas. Land abutting the Cranberry Bog Conservation Area and other downstream areas (e.g., Davidson Park) of the Southern Study Area are residential.

Based on a review of "The Directory of New England Manufacturers", the types of manufacturers or businesses that are located in Woburn include:

- Food and Kindred Products
- Apparel and Textile Products (made from fabrics)
- Lumber and Wood Products (excluding furniture)
- Furniture and Fixtures
- Printing, Publishing, and Allied Industries
- Chemicals and Allied Products
- Rubber and Miscellaneous Plastic Products
- Stone, Clay, Glass, and Concrete Products
- Fabricated Metal Products (except machinery and transportation equipment)
- Machinery (except electrical)
- Electrical and Electronic (machinery, equipment, and surplus)
- Transportation Equipment
- Measuring, Analyzing, and Controlling Instruments
- Miscellaneous Manufacturing Industries
- Wholesale Trade - Durable Goods
- Business Services
- Miscellaneous Repair Services
- Engineering Research Management and Related Services

One municipal sanitary landfill, the Woburn Sanitary Landfill, is located within the Northern Study Area. The landfill, a 54-acre solid waste disposal area, officially ceased operating in June 1986. Construction of the landfill cap was completed in 2003. In addition, a regional transportation facility, known as the Anderson Regional Transportation Center (RTC), centered around a commuter rail station and bus transport system is located on Industri-plex OU-1.

The Aberjona River is classified by the MassDEP as a Class B river. Class B waters are designated as a habitat for fish, other aquatic life, and wildlife, and for primary and secondary contact recreation. Where designated, Class B waters can be used as a source of public water supply with appropriate treatment. Class B waters are considered suitable for irrigation and other agricultural uses and for compatible industrial cooling and process uses. The current use of the Aberjona River and its associated wetlands and ponds (including the HBHA and HBHA wetlands) is for recreation. Recreational activities noted as occurring within these surface water bodies are primarily fishing and wading, with swimming occurring at one designated beach area (i.e., Sandy Beach) in Winchester. The river frequently floods low-lying floodplain areas associated with the MSGRP RI Study Area. It is unknown if the Aberjona River is used for industrial purposes such as cooling water or process use.

It is reasonably anticipated that future land use in the Northern Study Area will remain the same as defined by the current zoning laws (i.e., industrial and commercial use). Although recently closed, a child day care center that previously operated in the Northern Study Area indicates that this is a potential future use. In 1997, an "open space" designation was added to the Woburn zoning ordinance. The only significant parcels of land designated as "open space" within the MSGRP RI Study Area are a portion of the HBHA, a portion of the Wells G&H Wetland, and the Cranberry Bog Conservation Area. Future land use in the Southern Study Area is under evaluation by the City of Woburn. Although the most recent version of the City of Woburn's draft redevelopment plan released in February 2005 did not include future reuse plans for the interior wetlands at the Wells G&H site, the City of Woburn has historically had discussions and planning meetings regarding the construction of walking trails adjacent to the Wells G&H wetland. Although this is not a significant deviation from its current use, it would provide increased accessibility to contaminated areas if these walking trails are constructed. It should also be noted that as part of future flood mitigation measures, increased surface water storage capacity may occur within the watershed.

2. Groundwater Classification and Use

MassDEP Bureau of Waste Site Cleanup has developed a groundwater classification system for use in risk characterization at disposal sites. The three classes of groundwater (GW-1, GW-2 and GW-3) and contaminant criteria applying to each classification are established in the state's Massachusetts Contingency Plan (MCP). Groundwater is classified as GW-1 if it is located within a current or potential drinking water source area. The GW-2 classification applies to areas where there is the potential for migration of vapors from the groundwater to the air inside occupied structures and specifically applies to groundwater located within a 30-foot radius of an existing occupied building or structure, where the average annual depth to groundwater in the area is 15 feet or less. The GW-3 classification applies to groundwater that may impact surface water. All groundwater is considered a potential source of discharge to surface water and therefore is, at a minimum, categorized as GW-3 (310 CMR 40.0932).

The groundwater classifications for the MSGRP RI Study Area were identified by MassDEP and documented in their "Groundwater Use and Value Determinations" for the Industri-plex and Wells G&H sites (see below) at the request of EPA. The Use and Value Determinations were used by EPA in developing and evaluating site-specific risk assessment scenarios.

Overall, the purpose of the Use and Value Determination is to identify whether the aquifer at the Site should be considered a "high," "medium," or "low" use and value aquifer based on the balancing of eight factors:

- quantity or potential yield of the aquifer
- quality of the water within the aquifer
- if the aquifer is a current public drinking water supply
- if the aquifer is a current private drinking water supply
- likelihood and identification of future drinking water use
- other current or reasonable expected groundwater uses
- ecological value
- public opinion

Groundwater Use and Value Determination for the Industri-plex Site (Industri-plex OU-1 south to Interstate 95):

The MassDEP "Groundwater Use and Value Determination" for the Industri-plex Superfund Site (MassDEP, 1997 and 2004) concluded that the aquifer at Industri-plex OU-1 south to Interstate 95 within the Northern Study Area was of low use and value (see Figure F-1). MassDEP's Use and Value Determinations have been included as an Appendix C to this ROD.

The Industri-plex area aquifer was classified by MassDEP as a Non-Potential Drinking Water Source Area (NPDWSA) and of low use and value despite the presence of the two potential GW-1 areas (Phillip's Pond and south of the easternmost extension of the NSTAR [formerly BECO] right-of-way) because commercial development and other factors make it unlikely that public drinking water facilities would be developed in the areas.

Due to its designation as a low use and value NPDWSA, the MassDEP concluded that for the purposes of the risk assessment, the groundwater in the Industri-plex area is classified as GW-2 and GW-3. The GW-2 classification applies to any areas where there are occupied structures and the average depth to groundwater is 15 feet or less. At a minimum, the GW-3 classification applies to the entire Northern Study Area. The installation of commercial wells may be associated with non-potable groundwater uses such as irrigation, process water use, and the use of groundwater in a public car wash. Shallow groundwater throughout the Northern Study Area may also be exposed during construction and utility-related excavations.

As indicated in the section below, the edge of the Interim Wellhead Protection Area (IWPA) for Woburn municipal wells G&H is at Interstate 95, the southern boundary of the Northern Study Area. Although the wells are inactive, they are still considered a public water supply and the MCP requires that groundwater flowing into an IWPA must meet drinking water standards. Therefore, although the Northern Study Area groundwater is classified as GW-2 and GW-3, the groundwater at its southern border must meet GW-1 standards before entering the Wells G&H IWPA.

Groundwater Use and Value Determination for the Wells G&H Site:

The MassDEP "Groundwater Use and Value Determination" for the Wells G&H Superfund Site concluded the aquifer in the area of the Wells G&H Site (e.g., the Central Area Aquifer) is of medium use and value. Nearly the entire Wells G&H Site, including the wetlands, lies within the IWPA of municipal wells G&H. Although the wells are inactive, they are still considered a public water supply (see Figure F-2). MassDEP's Use and Value Determinations have been included as an Appendix C to this ROD.

Because the Wells G&H aquifer is within the IWPA and because it is a medium and high yield aquifer, the aquifer is classified under the MCP as a GW-1 area. The 0.5-mile radius of the IWPA takes precedence over areas excluded as non-drinking water source areas under the MCP; therefore, regardless of other designations the whole area within the IWPA is considered a current drinking water source area. Due to the development in the area, the GW-2 classification also potentially applies to areas where there is the potential migration of vapors from groundwater to occupied buildings. Lastly, all groundwater within the Commonwealth is, at a minimum, considered GW-3 which considers the ecological and human health impacts of groundwater discharge to surface water. The aquifer discharges into the Aberjona River and wetlands and must meet all applicable standards. Baseline risk assessment exposures scenarios should consider the above classifications. Groundwater within the Central Area (OU-2) of the Wells G&H Superfund Site is scheduled for comprehensive evaluation by EPA.

Groundwater Users

Based on the information available, there are no current groundwater users within the zone of influence of the contaminant plumes at the Industri-plex Site. The following section provides information on the current groundwater users within the City of Woburn, some of which may be recharged by the Aberjona River, as well as significant historical use.

The City of Woburn has historically withdrawn groundwater from the Horn Pond and Aberjona

River aquifers for its municipal water supply. Production wells installed near Horn Pond have been used since 1931. Production wells G and H were installed in 1964 and 1967, respectively, and used until 1979, when they were closed due to VOC contamination. Since these two wells were shut down in 1979, Woburn has received approximately 60 percent of its water supply from the Horn Pond wells and the remainder from the Massachusetts Water Resource Authority (MWRA). The City of Woburn has the only registered potential groundwater supply source in the study area, and is registered for a total water withdrawal of up to 4.2 million gallons per day (mgd) for use city-wide. The average water withdrawal from the Horn Pond wells is 3.7 mgd.

Groundwater wells used for irrigation, industrial processes, and monitoring exist throughout the MSGRP RI Study Area. Generally, it is assumed that these wells do not consistently withdraw a significant amount of groundwater, and therefore are not expected to have an influence on area-wide groundwater flow direction. However, the Atlantic Gelatin (Kraft Foods) industrial production wells have historically withdrawn significant amounts of groundwater from the Southern Study Area. Atlantic Gelatin has installed and operated a total of seven production wells; three are currently in operation. Presently, the total permitted withdrawal rate is 1 mgd. Approximately 800,000 gallons per day are withdrawn from Atlantic Gelatin wells located in Winchester, adjacent to the Aberjona River. The balance of approximately 200,000 gallons per day is withdrawn from Well No. 7, located in Woburn, near Whittemore Pond. Other historical users of groundwater for industrial process water have included the John J. Riley Leather Company, Johnson Brother's Roses, Independent Tallow, and Stauffer Chemical Company in Woburn; also J.O. Whitten and Parkview Apartments in Winchester (CDM, 1967). One of the two Riley tannery production wells was reported to yield 750 gpm and the Stauffer Chemical Company well(s) reportedly yielded 1 mgd.

G. SUMMARY OF SITE RISKS

A baseline risk assessment was performed to estimate the probability and magnitude of potential adverse human health and environmental effects from exposure to contaminants associated with Industri-plex OU-2 assuming no remedial action was taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. The public health risk assessment followed a four step process: 1) hazard identification, which identified those hazardous substances which, given the specifics of Industri-plex OU-2, were of significant concern; 2) exposure assessment, which identified actual or potential exposure pathways, characterized the potentially exposed populations, and determined the extent of possible exposure; 3) toxicity assessment, which considered the types and magnitude of adverse health effects associated with exposure to hazardous substances, and 4) risk characterization and uncertainty analysis, which integrated the three earlier steps to summarize the potential and actual risks posed by hazardous substances at the MSGRP RI Study Area, including carcinogenic and non-carcinogenic risks and a discussion of the uncertainty in the risk estimates.

Separate baseline risk assessments were completed for the Northern Study Area (Appendix 6 of the MSGRP RI) and the Southern Study Area (2004 Wells G&H OU-3 Aberjona River Study) to determine whether contaminated media (surface water, sediment, sediment cores, fish, soil, groundwater, and soil gas) pose risks to human and ecological receptors. These risk assessments were combined and evaluated as part of a comprehensive risk evaluation to support the MSGRP RI. In addition, a supplemental risk evaluation was performed as part of the October 2005 Technical Memorandum. The sampling locations/stations (e.g. WH, CB-03, SC-02, etc.) described below are illustrated in the MSGRP RI and, where appropriate, the October 2005 Technical Memorandum.

A summary of those aspects of the human health risk assessment which support the need for remedial action is discussed below followed by a summary of the environmental risk assessment.

1. Human Health Risk Assessment

Fifty-nine of the more than 125 chemicals detected at the MSGRP RI Study Area were selected for evaluation in the human health risk assessment as chemicals of potential concern. The chemicals of potential concern were selected to represent potential site-related hazards based on toxicity, concentration, frequency of detection, and mobility and persistence in the environment and can be found in Tables 3-2.1 through 3-2.8 of the Southern Study Area risk assessment, Tables 2.1 through 2.13 of the Northern Study Area risk assessment, and in Appendices C.1 (Tables 2.1 through 2.3) and C.3 (Table 1) of the October 2005 Technical Memorandum. From this, a subset of the chemicals were identified in the MSGRP FS as presenting a significant current or future risk and are referred to as the chemicals of concern in this ROD and summarized in Tables G-1 through G-7 for sediment, sediment cores, surface soil, subsurface soil, and groundwater (shallow and all depths combined). These tables contain the exposure point concentrations used to evaluate the reasonable maximum exposure (RME) scenario in the baseline risk assessment for the chemicals of concern. Estimates of average or central tendency exposure concentrations for the chemicals of concern and all chemicals of potential concern can be found in Tables 3-3.1 through 3-3.9 of the Southern Study Area risk assessment and Tables 3.1 through 3.11 of the Northern Study Area risk assessment.

Potential human health effects associated with exposure to the chemicals of potential concern were estimated quantitatively or qualitatively through the development of several hypothetical exposure pathways. These pathways were developed to reflect the potential for exposure to hazardous substances based on the present uses, potential future uses, and location of Industri-plex OU-2.

Exposure Assessment

Industri-plex OU-2 includes portions of Industri-plex OU-1 in Woburn, the HBHA Pond and HBHA wetland, and the Aberjona River and associated floodplain areas and wetlands between Industri-plex OU-1 and the Cranberry Bog Conservation Area. The Aberjona River flows through the Wells G&H Superfund Site, portions of which are included within Industri-plex OU-2. Interstate 95 crosses Industri-plex OU-2, east to west, and divides Industri-plex OU-2 into Northern and Southern Study Areas. A railroad right-of-way runs along the western boundary of Industri-plex OU-2. Land use in the vicinity of the Northern Study Area is commercial/industrial, while land use in the vicinity of the Southern Study Area is a mixture of commercial, industrial, recreational, and residential properties. There is a high likelihood that commercial/industrial use of the Northern Study Area will continue. The reuse of the Southern Study Area, as indicated by the City, will most likely be recreational. Also refer to Sections E and F of the ROD for more detailed descriptions of Industri-plex OU-2 features and land use.

The Northern Study Area and the surrounding area are served by a municipal drinking water sources that are not affected by Industri-plex OU-1. The municipal drinking water sources include Horn Pond aquifer situated in west Woburn, and Quabbin Reservoir situated in central Massachusetts. The aquifer within the Northern Study Area is classified by the State as both GW-2 (areas where there is a potential for migration of vapors to occupied structures) and GW-3 (considers impacts associated with the discharge of groundwater to surface water).

Groundwater within the Southern Study Area is scheduled for comprehensive evaluation by EPA as part of the Wells G&H Central Area Aquifer investigations and was not evaluated as part of the MSGRP RI. However, an evaluation was performed on the potential impact of river contamination on groundwater in the Wells G&H Central Area Aquifer, which concluded that arsenic in the river and wetland sediments and surface water would not adversely affect the development of large-capacity potable water supply wells in the Wells G&H Central Area Aquifer (see MSGRP RI, Appendix 5A). This conclusion was based on historical water quality data from municipal Wells G and H; information regarding the hydrologic relationship between the aquifer, the river and the wetlands; geochemical conditions existing in the aquifer; recent water quality data from the sampling of various monitoring wells and surface water stations during related investigations; and known and postulated geochemical behavior of the contaminants and associated metals, notably iron and manganese. These results suggest that arsenic in the river and sediments is unlikely to migrate to drinking water supply well(s) above its current drinking water standard (i.e. Maximum Contaminant Level (MCL) of 10 $\mu g/L$)).

The following is a brief summary of the exposure pathways that were found to present a significant risk. A more thorough description of all exposure pathways evaluated in the risk assessment including estimates for an average exposure scenario, can be found in Section 3.3 and on Tables 3.4.1 through 3.4.11 of the Southern Study Area risk assessment, in Section 3 and on

Tables 4.1 through 4.11 of the Northern Study Area risk assessment, and in Section 4 of the October 2005 Technical Memorandum. The following current exposure pathways were found to present a significant risk:

- Recreational user (adult and young child) with exposure to sediment (by ingestion and dermal contact) at Stations WH and CB-03 within the Southern Study Area.[1]

The following exposure pathways were found to present a potential significant risk in the future:

- Recreational user (adult and young child) with exposure to sediment (by ingestion and dermal contact) at Stations 13/TT-27, WH, NT-3, and CB-03 within the Southern Study Area.[2]
- Worker with exposure to sediment (by ingestion and dermal contact while dredging) at sediment core locations SC02, SC05, SC06, and SC08;[3]
- Child with exposure to surface and subsurface soil (by ingestion and dermal contact in a day care setting) within the former Mishawum Lake bed area of the Northern Study Area;[4]
- Construction worker with exposure to subsurface soil (by ingestion and dermal contact) within the former Mishawum Lake bed area and to shallow groundwater (by dermal contact) within the Northern Study Area;[5]
- Industrial worker (adult) with exposure to groundwater used as process water (by ingestion, dermal contact, and inhalation of volatile compounds released to the air during

[1] For current recreational sediment exposures, ingestion of 100 mg/day for 24 years was presumed for an adult. For a young child (age 1 to 6), ingestion of 200 mg/day for 6 years was presumed. Dermal contact was assumed with 5,700 cm^2 of surface area for the adult and 2,800 cm^2 for the child. Current sediment exposures at Stations CB-04 and WH were assumed to occur 104 days/year and 26 days/year, respectively.

[2] For future recreational sediment exposures, the ingestion rates, exposure durations, and surface areas were consistent with those used for current exposures. Future sediment exposures at Station CB-04 were assumed to occur 104 days/year. Future exposures at Stations 13/TT-27, WH, and NT-3 were assumed to occur 78 days/year.

[3] For the worker, exposures were presumed to occur 167 days/year for 2 years during dreding. Sediment ingestion exposures were evaluated using an ingestion rate of 200 mg/day. Dermal contact was assumed with 3,300 cm^2 of surface area.

[4] For child exposures, the ingestion rate, exposure duration, and surface area were consistent with those used for young child sediment exposures in a day care setting. Future day care child exposures were assumed to occur 150 days/year.

[5] For contaminated groundwater, ingestion of 50 mL/day, 125 days/year for 1 year was presumed for a construction worker. Dermal contact was assumed with 3,300 cm^2 of surface area. Soil exposures were evaluated using soil ingestion rate of 200 mg/day.

use) within the Northern Study Area;[6] and

- Car wash worker (adult) with exposure to groundwater used in a warm-water car wash (by inhalation of volatile compounds released to the air during use) within the Northern Study Area.[7]

Volatilization and dispersion models were used to estimate the levels of contaminants released from groundwater to air during process water use and the use of groundwater in a car wash. The Toxchem+ Model was used to model off-gassing of volatile compounds during industrial water usage as process water. The proportional extrapolation of the Foster & Chrostowski Shower Model was used to estimate airborne volatile compound levels inside a warm water car wash.

Toxicity Assessment

Excess lifetime cancer risks were determined for each exposure pathway by multiplying a daily intake level by the chemical specific cancer potency factor. Cancer potency factors have been developed by EPA from epidemiological or animal studies to reflect a conservative "upper bound" of the risk posed by potentially carcinogenic compounds. That is, the true risk is unlikely to be greater than the risk predicted. The resulting risk estimates are expressed in scientific notation as a probability (e.g. 1×10^{-6} or 1E-06 for 1/1,000,000) and indicate (using this example), that an average individual is not likely to have greater that a one in a million chance of developing cancer over 70 years as a result of site-related exposure (as defined) to the compound at the stated concentration. All risks estimated represent an "excess lifetime cancer risk" which is the risk in addition to the background cancer risk experienced by all individuals. The chance of an individual developing cancer from all other (non-site related) causes has been estimated to be as high as one in three. EPA's generally acceptable risk range for site-related exposure is 10^{-4} to 10^{-6}. Current EPA practice considers carcinogenic risks to be additive when assessing exposure to a mixture of hazardous substances. A summary of the cancer toxicity data relevant to the chemicals of concern is presented in Table G-8.

In assessing the potential for adverse effects other than cancer, a hazard quotient (HQ) is calculated by dividing the daily intake level by the reference dose (RfD) or other suitable benchmark. Reference doses have been developed by EPA and they represent a level to which an individual may be exposed that is not expected to result in any deleterious effect. RfDs are

[6] For contaminated groundwater, ingestion of 50 mL/day, 250 days/year for 25 years was presumed for an industrial worker. Dermal contact was assumed with 3,300 cm^2 of surface area. Inhalation of vapors released from groundwater was assumed to occur 8 hours/day. Airborne concentrations of volatile compounds were estimated using the Toxchem+ software package.

[7] For contaminated groundwater, inhalation of vapors released from groundwater for 8 hours/day, 250 days/year for 25 years was presumed for a car wash worker. Airborne concentrations of volatile compounds were estimated using a proportional extrapolation of the Foster & Chrostowski Shower Model.

derived from epidemiological or animal studies and incorporate uncertainty factors to help ensure that adverse health effects will not occur. A HQ ≤ 1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic non-carcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemical(s) of concern that affect the same target organ (e.g. liver) within or across those media to which the same individual may reasonably be exposed. A HI ≤ 1 indicates that toxic non-carcinogenic effects are unlikely. A summary of the non-carcinogenic toxicity data relevant to the chemicals of concern is presented in Table G-9.

A site-specific sediment arsenic bioavailability study was conducted to more accurately determine the degree to which arsenic is absorbed from sediments following incidental ingestion. The site-specific oral bioavailability estimate was applied to the oral cancer slope factor and oral reference dose to derive site-specific toxicity values applicable to the sediment incidental ingestion pathway only (Tables G-8 and G-9).

Risk Characterization

The following is a summary of the media and exposure pathways that were found to present a significant risk exceeding EPA's cancer risk range and/or non-cancer threshold. Only those exposure pathways deemed relevant to the remedy being proposed are presented in this ROD. Readers are referred to Section 3.5 and Tables 3.9.1 through 3.9.104 of the Southern Study Area risk assessment, Section 5 and Tables 9.1 through 9.39 of the Northern Study Area risk assessment, and Section 4 and Appendix C of the October 2005 Technical Memorandum for a more comprehensive risk summary of all exposure pathways evaluated for all chemicals of potential concern and for estimates of the central tendency risk.

<u>Recreational User – Current and Future</u>

Tables G-10 through G-12 depict the carcinogenic and non-carcinogenic risk summary for the chemicals of concern in sediment evaluated to reflect current and potential future recreational exposure corresponding to the RME scenario. For the current and future young child and adult recreational user, carcinogenic and non-carcinogenic risks exceeded the EPA acceptable risk range of 10^{-4} to 10^{-6} and HI of 1. The exceedances were due to the presence of arsenic in sediment for both the current (Stations WH and CB-03) and future (Stations 13/TT-27, WH. NT-3, and CB-03) scenarios. Benzo(a)pyrene was also a future risk contributor for Stations 13/TT-27 and WH.

<u>Dredging Worker - Future</u>

Table G-13 depicts the non-carcinogenic risk summary for the chemicals of concern in sediment cores evaluated to reflect potential future exposure for a dredging worker corresponding to the

RME scenario. For the dredging worker, non-carcinogenic risks exceeded the EPA target organ HI of 1. The exceedances were due primarily to the presence of arsenic in sediment cores SC02, SC05, SC06, and SC08.

Day Care Child - Future

Tables G-14 and G-15 depict the carcinogenic and non-carcinogenic risk summary for the chemicals of concern in surface and subsurface soil evaluated to reflect potential future exposure for a child in day care corresponding to the RME scenario. For the day care child, carcinogenic and non-carcinogenic risks for subsurface soil exceeded the EPA acceptable risk range of 10^{-4} to 10^{-6} and HI of 1. For surface soil, non-carcinogenic risks exceeded the EPA HI of 1. The exceedances were due primarily to the presence of arsenic in surface and subsurface soil. However, carcinogenic risk for surface soil was within the EPA acceptable range of 10^{-4} to 10^{-6}.

Construction Worker - Future

Table G-16 depicts the non-carcinogenic risk summary for the chemicals of concern in subsurface soil and shallow groundwater evaluated to reflect potential future exposure for a construction worker corresponding to the RME scenario. For the construction worker, non-carcinogenic risks exceeded the EPA target organ HI of 1. The exceedance was due primarily to the presence of arsenic in subsurface soil and shallow groundwater.

Industrial Worker - Future

Tables G-17 and G-18, respectively, depict the carcinogenic and non-carcinogenic risk summary for the chemicals of concern in groundwater evaluated to reflect potential future exposure for an industrial worker corresponding to the RME scenario. For the industrial worker using groundwater as process water, carcinogenic and non-carcinogenic risks exceeded the EPA acceptable risk range of 10^{-4} to 10^{-6} and HI of 1. The exceedances were due primarily to the presence of 1,2-dichloroethane, benzene, trichloroethene, naphthalene, and arsenic in groundwater.

Car Wash Worker - Future

Tables G-19 and G-20 depict the carcinogenic and non-carcinogenic risk summary for the chemicals of concern in groundwater evaluated to reflect potential future exposure for a car wash worker corresponding to the RME scenario. For the worker using groundwater in a car wash, carcinogenic and non-carcinogenic risks exceeded the EPA acceptable risk range of 10^{-4} to 10^{-6} and HI of 1. The exceedances were due primarily to the presence of 1,2-dichloroethane, ammonia, benzene, trichloroethene, and naphthalene in groundwater. Toluene in groundwater was not identified as contributing an unacceptable human health risk under these scenarios described above.

Even though low-flow sampling techniques were used to collect Northern Study Area groundwater samples, a number of monitoring wells could not be stabilized prior to the collection of groundwater samples. These samples may have contained elevated levels of suspended particulate materials, possibly resulting in an overestimate of the bioavailable contaminant levels in the samples and risk associated with the samples.

For the groundwater dermal contact pathways, risk associated with dermal absorption could not be quantified for all contaminants. Data needed to predict dermal absorption is insufficient for some compounds including pentachlorophenol. This uncertainty may result in an underestimation of carcinogenic risk. This uncertainty will be periodically reviewed and the models updated to address changes in the dermal absorption values during the five-year reviews.

Airborne concentrations of volatile compounds for the process water and car wash scenarios were estimated through the use of volatilization and dispersion models. Parameter values used in these models were selected to represent reasonable maximum exposures that may occur in the future during process water and car wash water usage. The risk associated with future groundwater use may be less than estimated should groundwater uses that result in a lesser degree of worker exposure be considered.

The City of Woburn's February 2005 draft redevelopment plan no longer includes the construction of a boardwalk (Station NT-1) or pier (Station NT-2) into the Wells G&H Wetland. Therefore, the risks and hazards identified for these two stations were not considered further in the ROD. Decisions concerning Stations NT-1 and NT-2 will be further reviewed when the redevelopment plan is finalized, if necessary, as part of the five-year review process.

2. Ecological Risk Assessment

The Comprehensive Ecological Risk Assessment (Chapter 7 of the MSGRP RI) presents a discussion of comprehensive risk results and associated uncertainties applicable to the river as a whole. The Comprehensive Ecological Risk Assessment is based on separate baseline risk assessments completed for the Northern Study Area and the Southern Study Area, and on the risk evaluation completed for the October 2005 Technical Memorandum to determine whether contaminated media (surface water, sediment, soil, and biota) pose risks to ecological receptors. The comprehensive risk assessment provided a refinement of risks, an evaluation of the ecological significance of risks, and determination of unacceptable ecological risks to ecological receptors.

Identification of Chemicals of Concern

Contaminants of potential concern (COPCs) were identified using an effects-based screening comparing the maximum contaminant concentrations to ecological benchmarks for each medium and within each exposure area. The COPCs were selected to represent potential site-related hazards based on toxicity, concentration, frequency of detection, mobility, and persistence in the environment. Summaries of the initial screening for sediment, soil, and surface water can be found in Tables 4-1 through 4-3, Table E.4-14 (Appendix E), and Table 4-16 of the Southern Study Area risk assessment (M&E, 2004) and Tables 1, 3, and 6 of the Northern Study Area risk assessment. Screening of ammonia in surface water can be found in Tables 4.1 and Appendix D of the October 2005 Technical Memorandum.

Surface water

Data used to identify COPCs in surface water are summarized in Tables G-21 and G-22. Selection of surface water COPCs was initially conducted with a limited data set and subsequently revised based on additional data collection (Aberjona River Study, Appendix E). The inorganic COPCs barium, cadmium, copper, iron, lead, manganese, and silver were initially identified at concentrations above screening values (Table G-21). The additional COPC screening (Table G-22) identified the inorganics barium, cadmium, cobalt, iron, manganese, silver, and zinc as exceeding surface water benchmarks. SVOCs were infrequently detected and represent a low risk to receptors in surface water. Surface water screening indicated a possible risk from exposure to benzene in HBHA Pond. Additional data collected as part of a Natural Attenuation Study (Ford, 2004; Ford, 2005) documented elevated concentrations of benzene and dissolved arsenic at depth in the HBHA Pond in April 2000 and 2001 and September 2004 (maxima of 2,530 μg/L and 5,043 μg/L, respectively). Elevated ammonia in surface water (maximum of 2,110 mg N/L) was also documented in HBHA Pond in the October 2005 Technical Memorandum.

Sediment

Data used to identify COPCs in sediment are summarized in Tables G-23 and G-24. In the Northern and Southern Study Areas respectively, fifty-two and fifty-eight chemicals detected in sediment were selected as COPCs due to exceedances of screening benchmark values or a lack of a screening benchmark value (VOCs, SVOCs, pesticides/PCBs, and inorganics).

Soil

In soils, beryllium, cobalt, and nickel were below screening values. The remaining 17 inorganics were above screening values and were retained as COPCs in soils (Table G-25). Separate samples to represent soils in terrestrial habitats were not collected in the Southern Study Area.

Instead, it was assumed that animals inhabiting the drier areas of the Aberjona River floodplain may also be exposed to COPCs in surficial sediment (*i.e.*, wetland soil during drier periods). Therefore, COPCs selected in sediment screening were used to evaluate receptor exposure to wetland soils in the Southern Study Area.

Exposure Assessment

The Site is located within the Aberjona River Watershed. The Aberjona River is the primary river system in the Aberjona River basin. The river flows through Woburn and Winchester, terminating in Winchester where it discharges into the Mystic Lakes. The primary habitats evaluated at the Site were the river, associated wetlands, and adjacent riparian habitats.

The most significant water bodies located at the MSGRP RI Study Area include: Halls Brook, HBHA and the Aberjona River. Within the Northern Study area, with the exception of Halls Brook, all of the water bodies were either modified or created for flood storage capacity during development of the area. Wetland areas adjacent to the Aberjona River are scattered throughout the MSGRP RI Study Area. The most significant wetland areas include the Wells G&H Wetland and the Cranberry Bog Conservation Area Wetland. The most significant downstream water bodies include the Upper and Lower Mystic Lakes, where the Aberjona River discharges.

The major exposure routes for the ecological receptors were through direct exposure to COPCs in sediment and surface water and through ingestion of contaminants through dietary exposures. In addition, risks to riparian species potentially exposed to COPCs in soils were evaluated. Terrestrial receptors may accumulate COPCs through consumption of contaminated prey and incidental soil ingestion. Aquatic and semi-aquatic receptors may be exposed to COPCs through ingestion of contaminated prey, sediment, and surface water. Exposure pathways, assessment endpoints, and measurement endpoints are summarized in Table G-26.

Receptor species were selected for exposure evaluation to represent various components of the food chain in the river/wetland ecosystem, and included: muskrat, green heron, mallard, short-tailed shrew, benthic invertebrates, and several species of warm water fish. In addition, in the Northern Study Area, a piscivorous mammal, the river otter, was also evaluated. There are no threatened or endangered species known to live within the MSGRP RI Study Area.

The exposure of surface water aquatic receptors was evaluated by a comparison of measured concentrations in each habitat area to surface water quality benchmarks. In addition, exposures of fish were evaluated through the comparison of tissue COPC concentrations of fish collected within the MSGRP RI Study Area to reference locations and tissue residue benchmarks.

The exposure of sediment-dwelling organisms (benthic invertebrates) to sediment COPCs was evaluated by a comparison of measured sediment concentrations to sediment quality benchmarks.

In addition, exposures of sediment invertebrates were evaluated through the comparison of tissue COPC concentrations of invertebrates collected within the MSGRP RI Study Area to reference locations.

To assist in exposure estimation for the wildlife indicator species (muskrat, otter, heron, mallard, and shrew), fish, invertebrates, and plants were collected from the MSGRP RI Study Area and analyzed to provide site-specific estimates of concentrations of food items used in the dietary exposure models. Exposure assumptions and exposure point concentrations for the wildlife models are presented in Appendix 7C of the MSGRP RI for the Northern Study Area and Tables 4-28 to 4-31 and Appendix E.1 for the Southern Study Area.

Ecological Effects Assessment

The potential effects of contaminant exposure on fish populations were evaluated through analysis of fish tissue COPC concentrations. In addition, population studies were conducted in order to document the fish community structure at HBHA Pond and HBHA Wetland Pond No. 3 as compared to two reference ponds.

The effect of sediment contaminants on sediment-dwelling benthic invertebrates was the subject of extensive analysis, including toxicity testing, invertebrate tissue analyses, and benthic invertebrate community studies. Data were used to evaluate the relationship of sediment contaminant concentrations, benthic invertebrate toxicity testing results, and benthic community composition data.

Estimates of dietary exposures for wildlife were quantified for each of the selected receptor species. Dietary exposure models were used to estimate exposure of each receptor species to each of the COPCs identified in the screening of sediment, surface water, and soil data (as applicable). The dietary doses were compared to mammalian and avian toxicity reference values (TRVs) obtained from the literature for each COPC.

Risk Characterization

The risks identified for each receptor were reviewed with consideration of the level of the risk to the population or community, the uncertainty associated with the analysis, and the amount and quality of the affected resource. The results were interpreted further within the context of the magnitude of the effect, the uncertainty of the estimates, and the ecological significance of the effect (Chapter 7 of the MSGRP RI). Summaries of estimated risks are presented for each receptor species or community in Table G-27.

Each endpoint has associated with it a magnitude of risk and a degree of uncertainty. The magnitude of risk incorporates both the degree to which the endpoint was exceeded and also the proportion of the habitat affected. Since the endpoints were population-based, a reasonable probability of risk was determined to be present only when a risk was present throughout the majority of the organism's habitat. The ecological significance related to each receptor/endpoint was evaluated in terms of factors defined by EPA. An evaluation of these factors is used to clarify if risks associated with contamination are present at levels that represent unacceptable ecological risk. Each of the six categories evaluated in Table G-27 were used to support a conclusion about the ecological significance of each endpoint where risk was identified. The magnitude of the potential risk was further considered when evaluating the significance of each factor.

Surface water data collected from the HBHA Pond as part of a Natural Attenuation Study (Ford, 2004) indicated elevated concentrations of dissolved arsenic in the deep water of the HBHA Pond. These values, up to 5,043 μg/L, greatly exceed the acute NRWQC. EPA (Ford, 2004) data indicate that these elevated values are most likely associated with sediment dissolution of arsenic to the over-lying water column. The concentration of benzene in the deep water of HBHA Pond also exceeded surface water benchmarks and there were exceedances of acute and chronic NRWQC in surface water of HBHA Pond. Additional data and risk evaluation completed for the October 2005 Technical Memorandum documented numerous exceedances of the NRWQC for ammonia throughout the HBHA Pond. The elevated concentrations of benzene, ammonia, and arsenic in the surface water of HBHA Pond represent a risk to aquatic receptors.

An evaluation of the benthic invertebrate measurement endpoints indicates that there were potential impacts from inorganic contaminants on invertebrate communities. There is evidence of severe toxicity to benthic organisms at the HBHA Pond. The toxicity testing results were highly correlated to sediment arsenic concentrations, particularly when the effect of high iron concentrations was taken into account. The summary of risk (Table G-27) indicates a difference in the magnitude of the risk to benthic invertebrates between the HBHA Pond and the remainder of the MSGRP RI Study Area. In the HBHA Pond, there is a high risk and confidence, based on several supporting lines of evidence, that there is severe toxicity and impairment of benthic communities. In the downgradient areas, the evidence indicates a low magnitude of toxicity, although there was a high correlation of effects with distribution of Site contaminants (primarily arsenic). Since benthic invertebrates provide important functions in aquatic ecosystems, the impact on the benthic community in the HBHA Pond, with severe toxicity and impairment of benthic communities, represents a significant ecological effect. Due to the magnitude of the adverse effect on this receptor community, the impact on the benthic community in the HBHA Pond represents an unacceptable ecological risk.

Based on the dietary modeling, there were negligible risks to green heron from exposure to COPCs. In addition, there were negligible risks to river otter from exposure to COPCs through dietary exposure. The majority of the diet for both green heron and river otter was based on consumption of fish.

Food chain modeling based on site-specific data indicated negligible risk to mallard duck from exposure to COPCs. For mallard, chromium, lead, and mercury posed low risk mainly within the Wells G&H Wetland, resulting from high sediment concentrations of these metals. The likelihood that high concentrations of sediment metals in limited areas of the Wells G&H Wetland will have serious population effects on a species with wide foraging ranges, like mallards, is low. Although habitat of the Wells G&H Wetland is considered to be of relatively high quality and local ecological significance, the low probability of impacts on the receptors result in low ecological significance of the effects on waterfowl. Hence, the impact on the mallard population is not considered an unacceptable ecological risk.

Based on the muskrat models, there is potential risk to muskrat (representative of semi-aquatic mammals) from ingestion of arsenic. These risks have been evaluated in the context of the limitations of the data and the models. Within this context the risk to muskrat exceeds levels potentially associated with harm (growth or reproduction), but the uncertainty associated with these estimates is high. The relatively low magnitude of the risk estimates (HQ values less than 10) and the high uncertainty associated with the models leads to a conclusion of low probability of significant population effects on muskrat. Based on the data collected, the risk assessment does not provide sufficient evidence to conclude that arsenic contamination is causing an adverse effect on muskrat populations that is of sufficient magnitude, severity, and extent that the population will not be maintained in an acceptable state. Hence, the impact on the muskrat population is not considered an unacceptable ecological risk.

The analysis of the selected indicators/endpoints indicates the only area of unacceptable ecological risk is in the HBHA Pond, where the potential risk to aquatic receptors is due to arsenic, benzene, and ammonia in surface water. The potential risk to the benthic invertebrate community is due to inorganic COPCs, especially arsenic.

In addition, evidence suggests that there is high exposure to inorganic COPCs, especially arsenic, for semi-aquatic mammals, bottom feeding fish, and small forage fish in several other areas of the MSGRP RI Study Area. However, in general, EPA has determined the resulting level of ecological risk for these receptors is low and not considered an unacceptable risk. COC concentrations expected to provide adequate protection of ecological receptors in the HBHA Pond are provided in Table G-28.

3. Basis for Response Action

Because the baseline human health and ecological risk assessments revealed that potential exposure to compounds of concern in soil, groundwater, surface water, and sediment via ingestion, dermal contact, and/or inhalation by human or ecological receptors may present an unacceptable human health risk (cancer risk greater than 10^{-4} and noncancer Hazard Index of 1), or unacceptable ecological risk (toxicity or exceedances of NRWQC and benchmarks), actual or threatened releases of hazardous substances from Industri-plex OU-2, if not addressed by implementing the response action selected in this ROD, may present an unacceptable risk to human health or the environment. In order to address these risks, the focus of the remedial action is soil within the former Mishawum Lake bed area, groundwater originating from Industri-plex OU-1, surface water in the HBHA Pond, and sediment within the HBHA Pond, Stations WH, NT-3, 13/TT-27, and CB-03, and sediment core locations SC02, SC05, SC06, and SC08.

H. REMEDIATION OBJECTIVES

Based on preliminary information relating to types of contaminants, environmental media of concern, and potential exposure pathways, response action objectives (RAOs) were developed to aid in the development and screening of alternatives. These RAOs were developed to mitigate, restore and/or prevent existing and future potential threats to human health and the environment. The RAOs for the selected remedy for Industri-plex OU-2 are:

- Within the Northern Study Area from (including) Industri-plex OU-1 to Interstate 95, prevent or mitigate the potential future exposure of workers via ingestion, dermal contact, and/or inhalation to concentrations of arsenic, benzene, ammonia, trichloroethene, 1,2-dichloroethane, and naphthalene in groundwater that may present a human health cancer risk in excess of 10^{-4} and target organ Hazard Index >1, so that the excess cancer risk attributable to this medium is within the range of 10^{-4} to 10^{-6} and the non-cancer Hazard Index does not exceed one.

- Within the Wells G&H Wetland and Cranberry Bog Conservation Area, reduce the current and future potential exposure of recreational adults and children via ingestion and dermal contact to concentrations of arsenic and benzo(a)pyrene in near-shore sediment that may present a human health cancer risk in excess of 10^{-4} and target organ Hazard Index >1, so that the excess cancer risk attributable to this medium is within the range of 10^{-4} to 10^{-6} and the non-cancer Hazard Index does not exceed one.

- Within the HBHA Wetland and Wells G&H Wetland, prevent or mitigate the potential future exposure of workers via ingestion and dermal contact to concentrations of arsenic in deeper (interior) sediment that may present a human health target cancer risk in excess of 10^{-4} and target organ Hazard Index >1, so that the excess cancer risk attributable to this medium is within the range of 10^{-4} to 10^{-6} and the non-cancer Hazard Index does not exceed one.

- Within the Former Mishawum Lake bed area, prevent or mitigate the potential future exposure of workers via ingestion and dermal contact to concentrations of arsenic in subsurface soil that may present a human health cancer risk in excess of 10^{-4} and target organ Hazard Index >1, so that the excess cancer risk attributable to this medium is within the range of 10^{-4} to 10^{-6} and the non-cancer Hazard Index does not exceed one.

- Within the Former Mishawum Lake bed area, prevent the potential future exposure of children via ingestion and dermal contact to concentrations of arsenic in surface and subsurface soil that may present a human health cancer risk in excess of 10^{-4} and target organ Hazard Index >1 such that the cancer risk attributable to this medium is within the range of 10^{-4} to 10^{-6} and the non-cancer Hazard Index does not exceed one.

- Prevent or minimize the exposure of benthic invertebrates and aquatic life to levels of arsenic, benzene, and ammonia in surface water, which are present as a result of groundwater discharge, in excess of applicable or relevant and appropriate requirements (ARARs) or benchmarks for the protection of aquatic life.

- Reduce the exposure of benthic invertebrates to levels of arsenic indicative of impairment in HBHA Pond sediment.

- Provide an alternate habitat to replace the lost wetland functions and values associated with portions of the HBHA Pond used as a component of the remedy.

- Minimize, to the extent practicable, the migration of soluble and particulate arsenic during storm events to downstream depositional areas.

I. DEVELOPMENT AND SCREENING OF ALTERNATIVES

1. Statutory Requirements/Response Objectives

EPA's primary responsibility at Superfund sites is to undertake remedial actions that are protective of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences, including: a requirement that EPA's remedial action, when complete, must comply with all federal and more stringent state environmental and facility siting standards, requirements, criteria or limitations, unless a waiver is invoked; a requirement that EPA select a remedial action that is cost-effective and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and a preference for remedies in which treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances is a principal element over remedies not involving such treatment. Response alternatives were developed consistent with these Congressional mandates.

2. Technology and Alternative Development and Screening

CERCLA and the National Contingency Plan (NCP) set forth the process by which remedial actions are evaluated and selected. In accordance with these requirements, a range of alternatives were developed for Industri-plex OU-2.

With respect to source control, the MSGRP RI/FS developed a range of alternatives in which treatment that reduces the toxicity, mobility, or volume of the hazardous substances is a principal element. This range included an alternative that removes or destroys hazardous substances to the maximum extent feasible, eliminating or minimizing to the degree possible the need for long-term management. This range also included alternatives that treat the principal threats posed by Industri-plex OU-2 but vary in the degree of treatment employed and the quantities and characteristics of the treatment residuals and untreated waste that must be managed; alternative(s) that involve little or no treatment but provide protection through engineering or institutional controls; and a no action alternative.

With respect to the groundwater response action, the MSGRP RI/FS developed a limited number of remedial alternatives that attain site-specific remediation levels within different time frames using different technologies; and a no action alternative.

As discussed in Section 2 of the FS, soil, sediment, groundwater, and surface water treatment technology options were identified, assessed and screened based on implementability, effectiveness, and cost. These technologies were combined into source control (SC) and management of migration (MM) alternatives. Section 3 of the FS presented the remedial alternatives developed by combining the technologies identified in the previous screening process in the categories identified in Section 300.430(e)(3) of the NCP. The purpose of the initial screening was to narrow the number of potential remedial actions for further detailed analysis while preserving a range of options. Each alternative was then evaluated in detail in Section 4 of the FS.

A total of 72 source control and management of migration remedial alternatives were screened in Section 2 of the FS for all impacted media including soil, groundwater, sediment, and surface water. Forty-four alternatives were retained as possible options for the cleanup of Industri-plex OU-2. From this initial screening, remedial options were combined, and a total of 27 alternatives were selected for detailed analysis. Although the alternatives are media-specific, in most cases, the media and alternatives are inter-related such that one alternative for a particular medium may impact the remedial alternative options for other downgradient media. For example, since contaminated groundwater discharges are responsible for sediment contamination in the HBHA Pond, any sediment alternative would be dependent upon the actions taken to eliminate the groundwater sources of contamination otherwise the sediment remedy could become re-contaminated.

With regard to the groundwater response action, based on site-specific conditions, the FS concluded that it is infeasible to eliminate arsenic groundwater contamination since the primary source of groundwater contamination (i.e., soil) addressed under OU-1 was capped and not removed. This large source area at Industri-plex OU-1, representing over 110 acres and potentially several million cubic yards of soil, will continue to impact groundwater. In addition, EPA has determined that groundwater will not be used in the future as a drinking water source (also refer to Section D of the ROD). As a result, alternatives selected for groundwater focused on management of migration rather than elimination of arsenic groundwater contamination.

J. DESCRIPTION OF ALTERNATIVES

This Section provides a narrative summary of the 27 remedial action alternatives that were retained from the screening conducted in Sections 2 and 3 of the FS and were developed to address the RAOs for the specific media of concern and were based on the environmental setting where the specific medium was located. These areas present unique challenges in addressing the contamination problems and typically require different methods and approaches to meet the RAOs. For example, sediments requiring remediation are located in three distinctly different areas that include: a large open water pond (HBHA Pond); shallow wetland areas where the water depth is generally less than 2 feet deep (near shore sediments of the Wells G&H Wetland and the Cranberry Bog Conservation Area); and buried deep sediments in deeper wetland areas of the river or stream channel in the HBHA Wetland and the Wells G&H Wetland. Remedial alternatives developed for one type of sediment may not be practical or feasible for another.

These 27 alternatives were formulated by combining technologies and general response actions retained following a screening evaluation of 72 technologies for effectiveness, implementability, and cost. Although the alternatives are media-specific, in most cases, the media and alternatives are inter-related such that one alternative for a particular medium may impact the remedial alternative options for other downgradient media. For example, since contaminated groundwater discharges are responsible for sediment contamination in the HBHA Pond, any sediment alternative would be dependent upon the actions taken to eliminate the groundwater sources of contamination, otherwise the sediment remedy could become re-contaminated. In summary, the alternatives by media are as follows:

<u>Surface Soil (0 to 3 feet below grade) in the former Mishawum Lake bed area (SS)</u>:

- Alternative SS-1: No Action
- Alternative SS-2: Institutional Controls with Monitoring
- Alternative SS-3: Permeable Cover and Monitoring with Institutional Controls
- Alternative SS-4: Excavation and Off-Site Disposal
- Alternative SS-5: Excavation , Treatment, and On-Site Reuse

Subsurface Soil (3 to 15 feet below grade) in the former Mishawum Lake bed area (SUB):

- Alternative SUB-1: No Action
- Alternative SUB-2: Institutional Controls with Monitoring
- Alternative SUB-3: Permeable Cover and Monitoring with Institutional Controls

Groundwater (GW):

- Alternative GW-1: No Action
- Alternative GW-2: Pond Intercept with Monitoring and Institutional Controls
- Alternative GW-3: Plume Intercept by Groundwater Extraction, Treatment and Discharge and Monitoring with Institutional Controls
- Alternative GW-4: Plume Intercept by In-Situ Groundwater Treatment and Monitoring with Institutional Controls

Halls Brook Holding Area Sediment (HBHA)

- Alternative HBHA-1: No Action
- Alternative HBHA-2: Monitoring
- Alternative HBHA-3: Subaqueous Cap
- Alternative HBHA-4: Storm Water Bypass and Sediment Retention with Partial Dredging and Providing an Alternate Habitat
- Alternative HBHA-5: Removal and Off-Site Disposal

Near Shore Sediments (NS)

- Alternative NS-1: No Action
- Alternative NS-2: Institutional Controls
- Alternative NS-3: Monitoring with Institutional Controls
- Alternative NS-4: Removal and Off-Site Disposal

Deep Sediments (DS)

- Alternative DS-1: No Action
- Alternative DS-2: Monitoring with Institutional Controls
- Alternative DS-3: Removal and Off-Site Disposal

Surface Water (SW)

- Alternative SW-1: No Action
- Alternative SW-2: Monitoring
- Alternative SW-3: Monitoring and Providing an Alternate Habitat

The individual detailed analysis of each alternative is provided in Section 4 of the Industri-plex MSGRP FS and in supporting Tables 4-1D through 4-27D. A general description and summary of the major components of each alternative is presented below.

SURFACE SOIL ALTERNATIVES (SS)

Alternative SS-1: No Action

Under this alternative, no remedial technologies would be implemented at Industri-plex OU-2 to reduce arsenic concentrations in surface soils in the former Mishawum lakebed area (see Figure J-1). No degradation of arsenic would be anticipated from naturally occurring processes; therefore no reduction in risks to human health would be achieved. Contaminants would remain at Industri-plex OU-2 above levels that allow for unlimited use and unrestricted exposure, therefore a formal review of Industri-plex OU-2 conditions and risks would need to be performed at least once every five years. The estimated cost for this alternative is $0.

Alternative SS-2: Institutional Controls With Monitoring

This is part of the selected remedy (see Section L). Alternative SS-2 (Institutional Controls with Monitoring) does not involve treatment or removal, but provides protection of human health by controlling potential exposures to contaminated soil through the implementation of institutional controls in the former Mishawum lakebed area. Institutional controls that would be implemented under this alternative would include prohibitions on the use of impacted properties for a day care facility and prohibitions on excavation without regulatory oversight and adequate worker health and safety precautions (engineering controls, personal protective equipment (PPE)) to minimize or prevent direct contact with contaminated soil during removal activities and to control the potential spread of contamination. Institutional controls will be developed and established to prevent exposures, where necessary. The form of institutional controls would be determined during pre-design and design in accordance with relevant guidance, policies and regulations.

- No degradation of arsenic is anticipated to occur from naturally occurring processes. Therefore, a groundwater monitoring component is included to ensure that contaminated soils that are left in place in the former Mishawum lakebed area do not impact groundwater and create unacceptable human health risks or hazards in the future. A network of permanent groundwater monitoring wells would be installed to enable groundwater monitoring. The estimated cost for this alternative is $0.6 Million

Alternative SS-3: Permeable Cover and Monitoring with Institutional Controls

Alternative SS-3 (Permeable Cover and Monitoring with Institutional Controls) does not involve treatment or complete removal of contaminated soil, but provides protection of human health by preventing or controlling potential exposures to contaminated soil through the construction of a protective barrier or cap over the contaminated soils in the former Mishawum lakebed area. Under this alternative, a permeable cover would be constructed to prevent future exposures to contaminated surface soil in the former Mishawum Lake bed area. Existing paved surfaces and building foundation and slabs would be evaluated for suitability as equivalent cover so that these surfaces would not have to be removed. Areas unsuitable as equivalent cover would require removal of surface soils (approximately 18 inches) and construction of an engineered permeable cover. In addition, institutional controls would be required to ensure that the cover, including equivalent structures such as asphalt paved areas and building foundations, is adequately protected through use restrictions and maintenance.

No degradation of arsenic is anticipated from naturally occurring processes. Therefore, a groundwater monitoring component is included to ensure that contaminated soils that are left in-place do not impact groundwater and create unacceptable human health risks or hazards in the future. A network of permanent groundwater monitoring wells would be installed to enable groundwater monitoring. The estimated cost for this alternative is $6 Million

<u>Alternative SS-4: Excavation and Off-Site Disposal</u>

Under this alternative, all source area materials exceeding the arsenic cleanup standards (presented in Part 2, Section L.4 of this ROD) in the former Mishawum lakebed area will be excavated and transported for off-site disposal at an approved, licensed facility. This alternative assumes that the soils underlying existing buildings would likely have been imported structural fill placed during construction of the building and will not require remediation. This alternative would provide permanent elimination of risks to human health resulting from future exposures to arsenic in surface soils. Note that if the pre-design investigation conducted to delineate the limits of contamination determine that the soils under a building do exceed the arsenic cleanup standards then institutional controls would be required until such time as the soils could be removed, such as during building demolition (see Alternative SS-2 for the components of institutional controls). The estimated cost for this alternative is $47.2 Million

<u>Alternative SS-5: Excavation, Treatment, and On-Site Reuse</u>

This alternative is identical to Alternative SS-4 (Excavation and Off-Site Disposal) except that the excavated soil contaminated at levels above cleanup standards in the former Mishawum lakebed area would be treated on-site to remove arsenic and then placed back into the excavations. No off-site disposal of wastes would be required except those wastes generated during the treatment process (i.e. contaminated rinsate).

This alternative would provide permanent elimination of risks to human health resulting from future exposures to arsenic in surface soils. Note that if the pre-design investigation conducted to delineate the limits of contamination determine that the soils under a building do exceed the arsenic cleanup standards, then institutional controls would be required until such time as the soils could be removed, such as during building demolition (see Alternative SS-2 for the components of institutional controls). The estimated cost for this alternative is $23 Million.

SUBSURFACE SOIL ALTERNATIVES (SUB)

Alternative SUB-1: No Action

Under this alternative, no remedial technologies would be implemented at Industri-plex OU-2 to reduce arsenic concentrations in subsurface soils in the former Mishawum lakebed area. No degradation of arsenic would be anticipated from naturally occurring processes, therefore no reduction in risks to human health would be achieved. Contaminants would remain at Industri-plex OU-2 above levels that allow for unlimited use and unrestricted exposure, therefore a formal review of Industri-plex OU-2 conditions and risks would need to be performed at least once every five years. The estimated cost for this alternative is $0.

Alternative SUB-2: Institutional Controls with Monitoring

This is part of the selected remedy (see Section L). Alternative SUB-2 (Institutional Controls with Monitoring) addresses soils within the zone of 3 feet to 15 feet below the surface that exceed the arsenic cleanup standards in the former Mishawum lakebed area (see Figure J-2). Human health risks and hazards associated with these contaminated subsurface soils are only present if the soils are excavated, causing a construction worker exposure; or excavated and re-distributed to the ground surface causing a potential exposure to a day care child. Alternative SUB-2 (Institutional Controls with Monitoring) is an alternative that does not involve treatment or removal, but provides protection of human health by preventing or controlling potential exposures to contaminated soil and prohibitions on excavation without regulatory oversight and adequate worker health and safety precautions (engineering controls, PPE) to minimize or prevent direct contact with contaminated soil during removal activities and to control the potential spread of contamination. Institutional controls will be developed and established to prevent exposures, where necessary. The form of institutional controls would be determined during pre-design and design in accordance with relevant guidance, policies and regulations.

No degradation of arsenic is anticipated from naturally occurring processes. Therefore, a groundwater monitoring component is included to ensure that contaminated soils that are left in-place do not impact groundwater and create unacceptable human health risks or hazards in the future. A network of permanent groundwater monitoring wells would be installed to enable groundwater monitoring. The estimated cost for this alternative is $1.3 Million.

Alternative SUB-3: Permeable Cover and Monitoring with Institutional Controls

Alternative SUB-3 (Permeable Cover and Monitoring with Institutional Controls) is similar to Alternative SS-3 (Permeable Cover with Institutional Controls) except that it addresses a considerably larger area, representing the locations with subsurface arsenic cleanup standards exceedances in the former Mishawum lakebed area. This alternative does not involve treatment, but provides protection of human health by preventing or controlling potential exposures to contaminated soil through the construction of a protective barrier or cap over the contaminated soils.

Under this alternative, a permeable cover would be constructed to prevent future exposures to contaminated subsurface soil in the former Mishawum lakebed area. As with Alternative SS-3 (Permeable Cover with Institutional Controls), existing paved surfaces and building foundation and slabs would be evaluated for suitability as equivalent cover, so that these surfaces would not have to be removed.

In order to construct the cap, limited removal of surface soils (approximately 18 inches) must be conducted to install the cover and maintain the existing grades. Since the area of surface soils requiring remediation is contained within the assumed limits of the subsurface soil remediation area, these soils (approximately 6,600 cubic yards) are assumed to exceed the arsenic cleanup standards and will require off-site disposal. All other surface soils within the limits of the subsurface soil remedy area are assumed to be below the arsenic cleanup standards and will be excavated, temporarily stockpiled, and later reused as backfill. In addition, institutional controls would be required to ensure that the cover, including the equivalent cover such as asphalt paved areas and building foundations, is protected through use restrictions and long-term maintenance.

No degradation of arsenic is anticipated from naturally occurring processes. Therefore, a groundwater monitoring component would be included to ensure that contaminated soils left in-place do not impact groundwater and create unacceptable human health risks or hazards in the future. A network of permanent groundwater monitoring wells would be installed to enable groundwater monitoring. The estimated cost for this alternative is $8.1 Million.

GROUNDWATER ALTERNATIVES (GW)

Alternative GW-1: No Action

Under this alternative, no remedial technologies would be implemented at Industri-plex OU-1 south to Interstate 95 within the Industri-plex OU-2 MSGRP RI Northern Study Area to reduce arsenic, ammonia, benzene, trichloroethene (TCE), naphthalene, or 1,2- dichloroethane (DCA) concentrations within groundwater (see Figure J-3 and J-4 for the approximate location of plumes). The alternative would not limit potential human or ecological exposures to contaminated groundwater and would not prevent future discharges of contaminated groundwater to surface water within the HBHA Pond. There would be no measures taken to restrict the future use of groundwater that is contaminated with these contaminants. Groundwater that is contaminated with arsenic would continue to migrate southward with the flow of groundwater and discharge into the HBHA Pond, and continue to provide a source of contamination to surface water and sediments in the HBHA Pond, the downstream HBHA Wetlands, the Aberjona River and adjacent wetlands. No degradation of arsenic is anticipated from naturally occurring processes. The estimated cost for this alternative is $0.

Alternative GW-2: Pond Intercept with Monitoring and Institutional Controls

This is part of the selected remedy (see Section L). Alternative GW-2 (Pond Intercept with Monitoring and Institutional Controls) is an alternative that involves little or no active treatment, but provides protection of human health by preventing or controlling potential exposures to contaminated groundwater (including arsenic, ammonia, benzene, TCE, naphthalene, 1,2-DCA: see Figure J-3 and J-4 for approximate location of contaminated groundwater plumes) through institutional controls. The alternative, in conjunction with HBHA-4 Alternative, also controls the downstream migration of the contaminated groundwater to areas in the HBHA Wetlands and the Aberjona River by intercepting it at the HBHA Pond. Natural processes in the HBHA Pond will degrade or sequester the contaminants of concern such that unacceptable amounts of contaminants will not migrate downstream of HBHA Pond. Alternative GW-2 (Pond Intercept with Monitoring and Institutional Controls) would rely upon other sediment and surface water alternatives to address these contaminants within the HBHA Pond itself. Institutional controls will be developed and established to prevent exposures, where necessary. The form of institutional controls would be determined during pre-design and design in accordance with relevant guidance, policies and regulations.

Although degradation of organics in site-wide groundwater is anticipated over time through natural processes, the degradation of arsenic is not expected. This alternative would not limit potential ecological exposures to contaminated groundwater in the HBHA Pond and would not prevent future discharges of contaminated groundwater to surface water within the HBHA Pond. Although contaminated groundwater would be intercepted at the HBHA Pond and contaminants would be sequestered at the Pond bottom, contaminated groundwater would continue to discharge into the HBHA Pond and continue to provide a source of contamination to surface water and sediments in the HBHA Pond. The estimated cost for this alternative is $3.9 Million.

Alternative GW-3: Plume Intercept by Groundwater Extraction, Treatment and Discharge and Monitoring with Institutional Controls

Alternative GW-3 (Plume Intercept by Groundwater Extraction, Treatment and Discharge with Institutional Controls and Monitoring) is an active groundwater extraction and treatment alternative. This alternative would consist of installing a groundwater extraction system that would capture groundwater from the overburden aquifer within the contaminant plumes that were delineated based on the results of the human health risk assessment prior to discharge into the HBHA Pond.

The implementation of Alternative GW-3 (Plume Intercept by Groundwater Extraction, Treatment and Discharge with Institutional Controls and Monitoring) would achieve several objectives through the extraction and treatment of contaminated groundwater originating from the Industri-plex OU-1. These include plume containment; prevention of the continued discharge of groundwater contaminants into the HBHA Pond; prevention of the continued migration of groundwater contaminants through surface water and sediments to the HBHA Pond, HBHA Wetlands, Aberjona River, and adjacent wetlands; and reduction of ecological risks observed in the HBHA Pond deep surface water and sediment due to contaminated groundwater discharges.

In addition, GW-3 would incorporate in-situ enhanced bioremediation through oxygen injection to treat the source areas for organic contaminants (benzene) at the West Hide Pile, an area located outside of the capture zone of the proposed groundwater extraction system.

Due to the presence of contaminants in soil throughout the Industri-plex OU-1 area, there will be continued leaching of contamination from the soil source areas that impacts groundwater such that the groundwater extraction system would not be expected to achieve RAOs within a reasonable time period. Therefore, institutional controls to prevent groundwater withdrawals would also be required under Alternative GW-3 (Plume Intercept by Groundwater Extraction, Treatment and Discharge with Institutional Controls and Monitoring) to address potential human health risks and hazards associated with direct contact, inhalation, and ingestion. The estimated cost for this entire alternative is $19.1 Million.

<u>Alternative GW-4: Plume Intercept by In-Situ Groundwater Treatment and Monitoring with Institutional Controls</u>

A portion of this alternative that applies to the West Hide Pile is part of the selected remedy (see Section L). Alternative GW-4 (Plume Intercept by In-Situ Groundwater Treatment and Monitoring with Institutional Controls) is an in-situ groundwater treatment alternative that incorporates two technologies to address both organic and inorganic contaminants in groundwater in the vicinity of the West Hide Pile; in-situ enhanced bioremediation through oxygen injection would be used to treat the source areas for organic contaminants (benzene, TCE, 1,2-DCA, and naphthalene) located between the East-Central Hide Pile and the South Hide Pile in the vicinity of Atlantic Avenue, and at the West Hide Pile for benzene; and a permeable reactive barrier (PRB) located between the southern perimeter of the NSTAR (formerly Boston Edison) right-of-way and the HBHA Pond would be used for the treatment of arsenic in groundwater prior to discharge to the Pond. Figure J-5 presents a conceptual representation of the location of the PRB and the location of the bio-enhancement treatment area at the West Hide Pile.

As with Alternative GW-3 (Plume Intercept by Groundwater Extraction, Treatment and Discharge with Institutional Controls and Monitoring), these two in-situ treatment processes together would achieve several objectives including prevention of continued migration of groundwater contaminants into the HBHA Pond, HBHA, and Aberjona River and reduction of ecological risks observed in the HBHA Pond deep surface water and sediment due to continued contaminated groundwater discharges. However, due to the nature of the PRB treatment (the PRB would intercept groundwater as it flows to the Pond rather than actively treat it throughout the groundwater plume area), concentrations of arsenic in excess of the cleanup standards would remain throughout the human health risk areas. Therefore, institutional controls that prohibit groundwater withdrawals would be required to address potential human health risks and hazards associated with direct contact, inhalation, and ingestion exposures. The estimated cost for this entire alternative is $17.8 Million. The estimated cost for the enhanced bioremediation portion only at the West Hide Pile is $3.8 Million.

HALLS BROOK HOLDING AREA SEDIMENT ALTERNATIVES (HBHA)

Alternative HBHA-1: No Action

Under this alternative, no remedial technologies would be implemented to reduce arsenic concentrations within the sediments of the HBHA Pond (also see Figure J-6 for area to be addressed). No degradation of arsenic is anticipated from naturally occurring processes within the HBHA Pond, therefore no reduction in ecological risk would be achieved. Five-year reviews would be required if this alternative were to be implemented. The estimated cost for this alternative is $0.

Alternative HBHA-2: Monitoring

Alternative HBHA-2 (Monitoring) incorporates long-term monitoring to evaluate possible changes to the nature and extent and migration patterns of contaminated sediments and risks to benthic invertebrates in the HBHA Pond over time. Alternative HBHA-2 (Monitoring) would not address ecological risks or control the migration of contaminated sediments to downstream areas. However, if contaminated groundwater discharges are eliminated (through interception of the groundwater contaminant plumes before it reaches the Pond, as provided by Alternative GW-3 or GW-4), natural processes such as biodegradation of organic contaminants and sedimentation and burial of inorganic contaminants may eventually reduce the exposure risks, toxicity, and mobility of the benzene and arsenic that is currently located in sediments at the Pond bottom. The estimated cost for this alternative is $1.2 Million.

Alternative HBHA-3: Subaqueous Cap

Alternative HBHA-3 (Subaqueous Cap) does not involve treatment or removal, but provides protection of the environment from contaminated sediments by preventing or controlling direct contact exposures to benthic invertebrates and by preventing migration of contaminated sediments from the HBHA Pond to downstream areas. Alternative HBHA-3 (Subaqueous Cap) includes the placement of a subaqueous cap consisting of a geotextile layer covered with clean permeable soil materials over contaminated sediments at the base of the HBHA Pond, creating a new benthic habitat and an effective barrier from existing sediment contaminants. Alternative HBHA-3 (Subaqueous Cap) would address ecological risks, but would not address the source of contamination (i.e. groundwater discharges) which could, over time, result in recontamination of the clean cap materials if a plume intercept alternative is not utilized to address groundwater. The estimated cost for this alternative is $5.3 Million.

Alternative HBHA-4: Storm Water Bypass and Sediment Retention With Partial Dredging and Providing an Alternate Habitat

This is part of the selected remedy (see Section L). Alternative HBHA-4 (Storm Water Bypass and Sediment Retention with Partial Dredging and Providing an Alternate Habitat) involves partial removal of contaminated sediments and reduces the mobility of soluble and particulate arsenic that is released from the HBHA Pond during storm events to downstream depositional areas. In the southern portion of the HBHA Pond where contaminated sediments are dredged and restored, this alternative would protect the environment by preventing exposure of benthic invertebrates to contaminated sediments. In the northern portion of the HBHA Pond where primary and secondary treatment cells/areas will be designed and constructed to sequester/treat contaminants and serve as sediment retention areas, this alternative would not protect the environment.

Alternative HBHA-4 (Storm Water Bypass and Sediment Retention with Partial Dredging and Providing an Alternate Habitat) would involve the construction of two low-head cofferdams designed to divide the HBHA Pond into three main areas (primary treatment area/cell, secondary treatment area/cell, and southern portion of the HBHA Pond area. The northern portion of the HBHA Pond includes the primary and secondary treatment areas/cells. The northern/first low-head cofferdam will be located to intercept all contaminated groundwater plumes (including arsenic, ammonia, benzene, TCE, naphthalene, 1,2-DCA; see Figure J-3 and J-4 for approximate location of contaminated groundwater plumes) discharging into the HBHA Pond. This first low-head cofferdam will establish the boundaries of the primary treatment cell which will sequester/treat contaminants and serve as a sediment retention area reducing contaminant migration. A southern/second low-head cofferdam would be constructed to the south of the first cofferdam to create a secondary treatment area/cell that would further sequester/treat contaminants in surface water that leaves the primary treatment cell through the use of aeration and sedimentation. In the future, contaminated sediments would be periodically dredged from the primary and secondary treatment cells to ensure they remain effective at preventing contaminant migration downstream of the northern portion of the HBHA Pond (effluent from the secondary treatment cell outlet).

A second component of Alternative HBHA-4 (Storm Water Bypass and Sediment Retention with Partial Dredging and Providing an Alternate Habitat) would be the diversion of stormflow from Halls Brook to avoid high flow volumes into the sediment retention area that would break down the chemocline within the primary treatment cell. A portion of the stormwater flow that would otherwise enter the northern portion of the HBHA Pond would instead be diverted to the south of the low-head cofferdams (downstream of the secondary treatment cell) so that baseflow conditions are maintained in the primary treatment cell. It is imperative that these baseflow conditions are continuously provided to the primary treatment cell so that the chemocline within the primary treatment cell is maintained.

Contaminated sediments containing arsenic at concentrations exceeding the cleanup standards would be dredged from the southern portions of the HBHA Pond located downstream of the second low-head cofferdam (south of the primary treatment cell outlet). Hydraulic dredging methods would be utilized to permanently remove contaminated sediments from these areas of the HBHA Pond. Sediments would be dewatered and transported to an approved licensed disposal facility. Periodic dredging in the primary and secondary treatment cells (sediment retention areas) would also be a component of this remedy to prevent excessive accumulation of sediments and maintain the integrity of the chemocline within the primary treatment cell, comply with the surface water cleanup standards at the outlet of the secondary treatment cell, and maintain the function of the sediment retention areas (primary and secondary treatment cells).

As part of Alternative HBHA-4 (Storm Water Bypass and Sediment Retention with Partial Dredging and Providing an Alternate Habitat), an impermeable liner would be placed along the open channel section of the New Boston Street Drainway to prevent to prevent the discharge of contaminated groundwater plumes, contamination of stream sediments, downstream migration of contaminants of concern, and potential impacts to other components of the selected remedy. The contaminated groundwater discharges could contaminate sediments in the channel and ultimately enable the transport of contaminated sediment (arsenic) into the southern portion of the HBHA Pond (the portion of the Pond from which contaminated sediments would be removed) during storm events.

Alternative HBHA-4 (Storm Water Bypass and Sediment Retention with Partial Dredging and Providing an Alternate Habitat) would also involve constructing a permeable cap along the northern banks of the HBHA Pond, located along the southern boundary of the Boston Edison right-of-way (A6 area) and adjacent to the railroad right of-way west of the HBHA Pond. This action would prevent soils contaminated with arsenic exceeding the HBHA Pond sediment cleanup standard from eroding into the northern portion of the Pond and impacting other components of the selected remedy.

Alternative HBHA-4 will receive continuous contaminated groundwater discharges for the foreseeable future, and the remedial design for Alternative HBHA-4 must take into consideration significant storm weather conditions (including hurricanes) to ensure durability, permanence, and long term performance.

In order to compensate for any wetland function and value losses that would occur from the use of the northern portion of the HBHA Pond (primary and secondary treatment cells) as a sediment retention area, Alternative HBHA-4 (Storm Water Bypass and Sediment Retention with Partial Dredging and Providing an Alternate Habitat) would involve wetland compensation nearby in the watershed.

Figure J-6 presents an approximate location of HBHA-4. Figure J-7 presents a conceptual representation of HBHA-4 (Storm Water Bypass and Sediment Retention with Partial Dredging and Providing an Alternate Habitat) including the location of the storm water bypass structure, the low-head cofferdams, and the soil/sediment erosion areas of concern.

Institutional controls will be developed and established to prevent exposures and protect the selected remedy, where necessary. The form of institutional controls would be determined during pre-design and design in accordance with relevant guidance, policies and regulations.

The estimated cost for this alternative is $9.2 Million.

Alternative HBHA-5: Removal and Off-Site Disposal

Under this alternative, all contaminated sediments in the HBHA Pond that exceed the arsenic cleanup standard would be removed using hydraulic dredging methods, dewatered, and transported off-site for disposal at an approved licensed facility. This alternative would provide permanent elimination of risks to ecological receptors resulting from exposures to contaminated sediments in the HBHA Pond, but would not address the source of contamination (i.e. groundwater discharges from Industri-plex OU-1) which would likely result in recontamination of the uncontaminated underlying or replacement substrate following dredging. In order for this alternative to be effective in the long-term, a plume intercept alternative would need to be implemented to address contaminated groundwater discharges to the HBHA Pond so that the dredged portions of the Pond are not re-contaminated.

In addition, Alternative HBHA-5 (Removal and Off-Site Disposal) would prevent arsenic-contaminated groundwater from discharging into the New Boston Street Drainway, which eventually discharges to Halls Brook, and would prevent arsenic-contaminated soils located along the southern boundary of the Boston Edison right-of-way (A6 area) from eroding into the northern portion of the HBHA Pond and contributing to the contaminated sediment load in the system.

The estimated cost for this alternative is $3.8 Million.

NEAR SHORE SEDIMENT ALTERNATIVES (NS)

Alternative NS-1: No Action

Under this alternative, no remedial technologies would be implemented to reduce arsenic concentrations in sediments within the near shore areas. These areas are located in the Well G&H Wetland and the Cranberry Bog Conservation Area (see Figure J-8). This alternative would not reduce the risks to human health and would require the five-year reviews to periodically address conditions and risks. The estimated cost for this alternative is $0.

Alternative NS-2: Institutional Controls

Alternative NS-2 (Institutional Controls) is an alternative that does not involve treatment or removal, but provides protection of human health by preventing or controlling potential exposures to contaminated sediment through installation of fencing to restrict access to contaminated sediment and through the imposition of institutional controls on impacted properties to prevent activities that might result in unacceptable exposures to contaminated near-shore sediments in the Wells G&H Wetland and the Cranberry Bog Conservation Area. Institutional controls will be developed and established to prevent exposures, where necessary. The form of institutional controls would be determined during pre-design and design in accordance with relevant guidance, policies and regulations.

Alternative NS-2 (Institutional Controls) would achieve no risk reduction beyond that which would be provided by restricting access to contaminated near-shore sediments. The estimated cost for this alternative is $0.3 Million.

Alternative NS-3: Monitoring with Institutional Controls

Alternative NS-3 (Monitoring with Institutional Controls) incorporates long-term monitoring to evaluate possible changes to the nature and extent and migration patterns of contaminated sediments in the near-shore areas in the Wells G&H Wetland and the Cranberry Bog Conservation Area, combined with institutional controls as a remedy for near-shore contaminated sediment. Natural processes that may reduce the potential exposures and risks may include burial of the contaminated sediments by accumulation of uncontaminated sediments thus limiting the accessibility and risks due to direct contact exposures. Under this alternative, institutional controls would also be implemented to prevent future exposures to contaminated sediment in the vicinity of sampling stations where potential human health risks and hazards were identified. Finally, installation of a permanent barrier (i.e. chain link fence) would prevent access to contaminated sediments and human health risks associated with recreational exposures through direct contact.

The estimated cost for this alternative is $1.8 Million.

Alternative NS-4: Removal and Off-Site Disposal

This is part of the selected remedy (see Section L). Under this alternative, all near-shore contaminated sediments in the Wells G&H Wetland and the Cranberry Bog Conservation Area exceeding the arsenic cleanup standards will be removed using mechanical excavation methods, dewatered, and transported off-site for disposal at an approved licensed facility. This alternative would provide permanent elimination of risks to humans resulting from exposures to contaminated near-shore sediments. As defined in the March 2005, MSGRP RI, near-shore sediments are those sediments which extend perpendicularly from the shoreline to a distance of approximately 30 feet into the wetland.

The estimated cost for this alternative is $3.2 Million.

DEEP SEDIMENT ALTERNATIVES (DS)

Alternative DS-1: No Action

Under this alternative, no remedial technologies would be implemented to reduce arsenic concentrations in sediments located in deeper sediment cores collected in the river channel near the Wells G&H Wetland and the Cranberry Bog Conservation Area (see Figure J-9). This alternative would not reduce the risks to human health and would require the performance of five-year reviews. The estimated cost for this alternative is $0.

Alternative DS-2: Monitoring with Institutional Controls

This is part of the selected remedy (see Section L). Alternative DS-2 (Monitoring with Institutional Controls) would address risks from future exposures to deep sediments near the Wells G&H Wetland and the Cranberry Bog Conservation Area by prohibitions on excavation without regulatory oversight and adequate worker health and safety precautions (engineering controls, PPE) to minimize or prevent direct contact with contaminated sediments during dredging/removal activities and to control the potential spread of contamination. Generally, these sediments are not accessible to humans except for in a dredging scenario, therefore prohibitions or restrictions on dredging would be an effective deterrent to potential future exposures to sediment in the deep sediment human health risk areas. Institutional controls will be developed and established to prevent exposures, where necessary. The form of institutional controls would be determined during pre-design and design in accordance with relevant guidance, policies and regulations.

The estimated cost for this alternative is $0.5 Million.

Alternative DS-3: Removal and Off-Site Disposal

Under this alternative, all deep sediments near the Wells G&H Wetland and the Cranberry Bog Conservation Area associated with sediment core sample locations exceeding the arsenic cleanup standards will be removed using mechanical excavation methods, dewatered, and transported off-site for disposal at an approved licensed facility. This alternative would provide permanent elimination of risks and hazards to humans resulting from exposures to contaminated deep sediment.

The estimated cost for this alternative is $117.4 Million.

SURFACE WATER ALTERNATIVES (SW)

Alternative SW-1: No Action

Under this alternative, no remedial technologies would be implemented to reduce arsenic and benzene concentrations within deep surface water of the HBHA Pond. The alternative would not limit potential ecological exposures to contaminated surface water. This alternative does not reduce ecological risks nor prevent the downstream migration of arsenic contaminated sediments and would require the performance of 5-year reviews. The estimated cost for this alternative is $0.

Alternative SW-2: Monitoring

This is part of the selected remedy (see Section L). Alternative SW-2 (Monitoring) is an alternative that involves no active treatment, but monitors the status of contamination that may or may not be attenuated by natural processes or other selected groundwater and sediment remedial alternatives. Although degradation of organic contaminants in the deeper surface water of the HBHA Pond is anticipated through natural processes, the degradation of arsenic is not expected unless the sources of contamination (i.e. groundwater discharges and arsenic dissolution from contaminated sediments) are eliminated through implementation of a plume intercept alternative and a sediment removal alternative that addresses the northern portion of the Pond. As such, this alternative would not be fully protective of the environment (i.e. aquatic organisms) unless implemented in conjunction with other media-specific alternatives whereby the sources of contamination (i.e. groundwater discharges and arsenic dissolution from contaminated sediments) are eliminated.

The estimated cost for this alternative is $3.2 Million.

Alternative SW-3: Monitoring and Providing an Alternate Habitat

The monitoring component of Alternative SW-3 (Monitoring and Providing an Alternate Habitat) is identical to that which is included in Alternative SW-2. As discussed above, unless the sources of contamination (i.e. contaminated groundwater and sediments) are addressed through other media-specific alternatives, natural processes are not expected to attenuate contaminants to concentrations that do not reflect impairment to aquatic organisms. To mitigate the loss of aquatic habitat within the affected area and meet the RAO, a similar wetland would be constructed to compensate for the loss and to maintain the functions and values of the benthic community and wetland habitat within the watershed.

The estimated cost for this alternative is $10.8 Million.

K. SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

Section l2l(b)(1) of CERCLA presents several factors that at a minimum EPA is required to consider in its assessment of alternatives. Building upon these specific statutory mandates, the NCP articulates nine evaluation criteria to be used in assessing the individual remedial alternatives.

A detailed analysis was performed on the alternatives using the nine evaluation criteria in order to select a Industri-plex OU-2 remedy. The following is a summary of the comparison of each alternative's strength and weakness with respect to the nine evaluation criteria. These criteria are summarized as follows:

Threshold Criteria

The two threshold criteria described below must be met in order for the alternatives to be eligible for selection in accordance with the NCP:

1. **Overall protection of human health and the environment** addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced or controlled through treatment, engineering controls, or institutional controls.

2. **Compliance with applicable or relevant and appropriate requirements (ARARs)** addresses whether or not a remedy will meet all Federal environmental and more stringent State environmental and facility siting standards, requirements, criteria or limitations, unless a waiver is invoked.

Primary Balancing Criteria

The following five criteria are utilized to compare and evaluate the elements of one alternative to another that meet the threshold criteria:

3. **Long-term effectiveness and permanence** addresses the criteria that are utilized to assess alternatives for the long-term effectiveness and permanence they afford, along with the degree of certainty that they will prove successful.

4. **Reduction of toxicity, mobility, or volume through treatment** addresses the degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume, including how treatment is used to address the principal threats posed by the site.

5. **Short-term effectiveness** addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until cleanup goals are achieved.

6. **Implementability** addresses the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

7. **Cost** includes estimated capital and Operation Maintenance (O&M) costs, as well as present-worth costs.

Modifying Criteria

The modifying criteria are used as the final evaluation of remedial alternatives, generally after EPA has received public comment on the MSGRP RI/FS and Proposed Plan:

8. **State acceptance** addresses the State's position and key concerns related to the preferred alternative and other alternatives, and the State's comments on ARARs or the proposed use of waivers.

9. **Community acceptance** addresses the public's general response to the alternatives described in the Proposed Plan and MSGRP RI/FS report.

Following the detailed analysis of each individual alternative, a comparative analysis, focusing on the relative performance of each alternative against the nine criteria, was conducted. This comparative analysis can be found in Tables 4-28A through 4-28G and Table 4-29 of the Industri-plex MSGRP FS, and attached to this ROD as Tables K-1 through K-9.

The section below presents the nine criteria and a brief narrative summary of the alternatives and the strengths and weaknesses according to the detailed and comparative analysis. Only those alternatives which satisfied the first two threshold criteria were balanced and modified using the remaining seven criteria. There were a total of 27 alternatives evaluated to address Surface Soils (SS), Subsurface Soils (SUB), Groundwater (GW), Halls Brook Holding Area Sediments (HBHA), Near Shore Sediments (NS), Deeper Wetland Sediments (DS), and Surface Water (SW). The evaluation of these alternatives for SS, SUB, GW, HBHA, NS, DS and SW are described under the threshold and primary balancing criteria below.

1. OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describers how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

Surface Soil (SS): The No Action Alternative, SS-1, does not protect human health or the environment. The Preferred Alternative, SS-2, would be protective of human health and the environment through institutional controls in the former Mishawum lakebed prohibiting the use of the property for day care facilities and prohibiting excavation without regulatory oversight and appropriate precautions. Alternative SS-3 would provide enhanced protection, since a permeable cover or barrier would further restrict exposure to contaminated surface soil in the former Mishawum lakebed. Alternatives SS-4 and SS-5 provide the highest level of protection for human health and the environment because all contaminated surface soil in the former Mishawum lakebed exceeding the proposed cleanup standards would either be removed off-site or treated.

Subsurface Soil (SUB): The No Action Alternative, SUB-1, does not protect human health or the environment. The preferred alternative, SUB-2, would provide protection from exposure to contaminated soils in the former Mishawum lakebed through institutional controls prohibiting excavation without regulatory oversight and appropriate precautions. Alternative SUB-3 would provide enhanced protection since a permeable cover or barrier would further restrict exposure to contaminated subsurface soil in the former Mishawum lakebed. This alternative also requires institutional controls and land use restrictions to protect the integrity of the cover.

Groundwater (GW): The No Action Alternative, GW-1, does not protect human health or the environment. The Preferred Alternative, GW-2, would provide protection from exposure to contaminated groundwater through institutional controls. Alternatives GW-3 and GW-4 would provide enhanced protection to human health and the environment through institutional controls restricting groundwater use.

Halls Brook Holding Area Pond Sediments (HBHA): Neither the No Action Alternative, HBHA-1, nor HBHA-2, which calls for monitoring, would be protective of the environment. Alternative HBHA-3, which calls for the installation of a permeable cover or barrier over contaminated sediments in the bottom of the pond, may provide enhanced protection for benthic organisms. However, this alternative requires that groundwater discharges to the pond be eliminated, otherwise the cap materials could become re-contaminated. The preferred alternative, HBHA-4, which calls for the removal of contaminated sediments from the southern portion of HBHA Pond, would provide protection to benthic invertebrates in this area of the pond. Since the northern portion of the pond would be incorporated into the cleanup remedy and used to treat contaminated groundwater discharges, this area would not provide protection to the benthic organisms in the short-term. However, an alternative wetland would be constructed in its place. Alternative HBHA-5 provides the highest level of protection for the environment because all contaminated sediment in the northern and southern portions of HBHA Pond would be removed. However, this alternative also requires that groundwater discharges to HBHA Pond be eliminated so that the pond does not become re-contaminated.

Near Shore Sediments (NS): The No Action Alternative, NS-1, does not protect human health. Alternatives NS-2 and NS-3 would provide protection from exposure to contaminated sediments in the Wells G&H Wetland and the Cranberry Bog Conservation Area through institutional controls. NS-3 would also include periodic monitoring. The Preferred Alternative, NS-4, provides the highest level of protection for human health because all contaminated sediments in the Wells G&H Wetland and the Cranberry Bog Conservation Area exceeding the cleanup standards would be removed.

Deeper Wetland Sediments (DS): The No Action Alternative, DS-1, does not protect human health. The Preferred Alternative, DS-2, would provide protection from exposure to deeper contaminated sediments near the Wells G&H Wetland and the Cranberry Bog Conservation Area through institutional controls. Alternative DS-3 provides the highest level of protection for human health because all contaminated sediments exceeding the cleanup standards would be removed. However, the marginal benefit derived from Alternative DS-3 over Alternative DS-2 would be low, since these sediments are inaccessible to humans.

Surface Water (SW): The No Action Alternative, SW-1, does not protect the environment. The Preferred Alternative, SW-2, which includes monitoring, and Alternative SW-3, which includes monitoring and the construction of an alternate wetlands habitat, would be protective if implemented in conjunction with other groundwater cleanup alternatives.

2. COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE ENVIRONMENTAL REGULATIONS (ARARS):

Section 121(d) of CERCLA requires that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4). Applicable requirements are those substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address hazardous substances, the remedial action to be implemented at the site, the location of the site, or other circumstances present at the site. Relevant and appropriate requirements are those substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law which, while not applicable to the hazardous materials found at the site, the remedial action itself, the site location or other circumstances at the site, nevertheless address problems or situations sufficiently similar to those encountered at the site that their use is well-suited to the site. Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statues or provides a basis for invoking a waiver.

Surface Soil (SS): The No Action Alternative, SS-1, does not comply with the ARARs. The Preferred Alternative, SS-2, and Alternatives SS-3, SS-4 and SS-5 would comply with all ARARs. For a detailed analysis, refer to Tables 4-1A-D, 4-2A-D, 4-3A-D, 4-4A-D and 4-5A-D in the Industri-plex OU-2 MSGRP FS.

Subsurface Soil (SUB): The No Action Alternative, SUB-1, does not comply with ARARs. The Preferred Alternative, SUB-2, and Alternative SUB-3 would comply with all ARARs. For a detailed analysis, refer to Tables 4-6A-D, 4-7A-D and 4-8A-D in the Industri-plex OU-2 MSGRP FS.

Groundwater (GW): The No Action Alternative, GW-1, does not comply with ARARs. The Preferred Alternative, GW-2, and Alternatives GW-3 and GW-4 would comply with all ARARs through institutional controls restricting groundwater use. For a detailed analysis, refer to Tables 4-9A-D, 4-10A-D, 4-11A-D and 4-12A-D in the Industri-plex OU-2 MSGRP FS.

Halls Brook Holding Area Pond Sediments (HBHA): The No Action Alternative, HBHA-1, and Alternative HBHA-2 do not comply with ARARs. Alternative HBHA-3, the Preferred Alternative, HBHA-4, and HBHA-5 would comply with all ARARs. For a detailed analysis, refer to Tables 4-13A-D, 4-14A-D, 4-15A-D, 4-16A-D and 4-17A-D in the Industri-plex OU-2 MSGRP FS.

Near Shore Sediments (NS): The No Action Alternative, NS-1, does not comply with ARARs. Alternatives NS-2 and NS-3 would comply with some, but not all ARARs. The Preferred

Alternative, NS-4, would comply with all ARARs. For a detailed analysis, refer to Tables 4-18A-D, 4-19A-D, 4-20A-D and 4-21A-D in the Industri-plex OU-2 MSGRP FS.

Deeper Wetland Sediments (DS): The No Action Alternative, DS-1, does not comply with ARARs. Alternative DS-2, which includes monitoring and institutional controls, would meet the ARARs. Alternative DS-3, which removes and disposes of contaminated sediments off-site, complies with all ARARs. For a detailed analysis, refer to Tables 4-22A-D, 4-23A-D and 4-24A-D in the Industri-plex OU-2 MSGRP FS.

Surface Water (SW): The No Action Alternative, SW-1, would not comply with ARARs. If implemented in conjunction with other groundwater and sediment remedial alternatives, such as Alternative HBHA-4, Alternative SW-2, which provides monitoring, and Alternative SW-3, which provides monitoring and an alternate habitat, would comply with ARARs at the outlet of the northern portion of the HBHA Pond (effluent from the secondary treatment cell) if they were implemented in conjunction with other groundwater and sediment alternatives. For a detailed analysis, refer to Tables 4-25A-D, 4-26A-D and 4-27A-D in the Industri-plex OU-2 MSGRP RI/FS.

3. LONG-TERM EFFECTIVENESS AND PERMANENCE:

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk and the adequacy and reliability of controls.

Surface Soil (SS): The No Action Alternative, SS-1, does not provide any long-term effectiveness or permanence. The Preferred Alternative, SS-2, would provide long-term effectiveness and permanence through institutional controls in the former Mishawum lakebed area. Alternative SS-3 would provide additional long-term effectiveness and permanence through institutional controls prohibiting disturbance of the cover in that area. Alternatives SS-4 and SS-5 provide the highest degree of long-term effectiveness and permanence because the contaminated soil in the former Mishawum lakebed would be removed.

Subsurface Soil (SUB): The No Action Alternative, SUB-1, does not provide any long-term effectiveness or permanence. The Preferred Alternative, SUB-2, would provide long-term effectiveness and permanence through institutional controls in the former Mishawum lakebed area. Alternative SUB-3 would also provide long-term effectiveness and permanence through institutional controls prohibiting disturbance of the cover in the former Mishawum lakebed.

Groundwater (GW): The No Action Alternative, GW-1, does not provide any long-term effectiveness or permanence. GW-2, the Preferred Alternative, would provide long-term effectiveness and permanence through institutional controls limiting groundwater use. Alternatives GW-3 and GW-4 would also be effective in the long-term, however GW-3 would require more extensive operation and maintenance than GW-4.

Halls Brook Holding Area Pond Sediments (HBHA): The No Action Alternative, HBHA-1, does not provide any long-term effectiveness or permanence. Alternative HBHA-2 would provide marginal long-term effectiveness and permanence, and long-term monitoring would be required to evaluate risks associated with contaminants left in place. Alternative HBHA-3 would provide enhanced long-term effectiveness and permanence provided there is no erosion of the permeable cover and contamination from groundwater discharges is eliminated. The Preferred Alternative, HBHA-4, provides a greater level of long-term effectiveness since a majority of contaminated sediments would be removed from the southern portion of HBHA Pond. Alternative HBHA-5 would provide the highest level of long-term effectiveness and permanence because the contaminated sediment would be removed off-site, assuming in conjunction with the GW alternatives that contaminated groundwater plumes no longer discharge into HBHA Pond.

Near Shore Sediments (NS): The No Action Alternative, NS-1, does not provide any long-term effectiveness or permanence. Alternatives NS-2 and NS-3 would provide long-term effectiveness and permanence through institutional controls in the Wells G&H Wetland and the Cranberry Bog Conservation Area. The Preferred Alternative, NS-4, provides the highest degree of long-term effectiveness and permanence because the sediments in the Wells G&H Wetland and the Cranberry Bog Conservation Area exceeding the cleanup standards would be excavated.

Deeper Wetland Sediments (DS): The No Action Alternative, DS-1, does not provide any long-term effectiveness or permanence. The Preferred Alternative DS-2, would provide long-term effectiveness and permanence through institutional controls for the deep river sediments near the Wells G&H Wetland and the Cranberry Bog Conservation Area. Alternative DS -3 provides the highest degree of long-term effectiveness and permanence because the sediments in these areas exceeding the cleanup standards would be excavated.

Surface Water (SW): The No Action Alternative, SW-1, does not provide any long-term effectiveness or permanence. The Preferred Alternative, SW-2, which includes monitoring, and Alternative SW-3, which also includes monitoring provide greater long-term effectiveness. Alternative SW-3 provides the greatest level of permanence by creating an alternate wetlands habitat.

4. REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT:

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

Surface Soil (SS): The No Action Alternative, SS-1, the Preferred Alternative, SS-2, and Alternative SS-3 do not include treatment. Alternative SS-4 may provide limited off-site treatment, if necessary, to qualify for disposal of soils excavated from the former Mishawum lakebed area at a licensed landfill. Alternative SS-5 reduces the toxicity and mobility of the contaminants by using a "soil washing" process to remove arsenic from this soil before using the treated soil as backfill.

Subsurface Soil (SUB): The No Action Alternative, SUB-1, the Preferred Alternative, SUB-2, and Alternative SUB-3 do not reduce toxicity, mobility or volume through treatment or other means.

Groundwater (GW): The No Action Alternative, GW-1, offers no treatment other than long-term natural attenuation processes that may occur with organic contaminants. The Preferred Alternative, GW-2, controls the migration of contaminated groundwater by intercepting contamination at the HBHA Pond, and makes use of the naturally occurring processes in HBHA Pond to precipitate metals and degrade organic contaminants. Alternative GW-2 does not actively treat groundwater prior to discharge to HBHA Pond, except for natural attenuation processes that may occur. When combined with Alternative HBHA-4, as EPA is proposing to do, GW-2 would control or reduce downstream migration of inorganic contaminants during storm events. Both Alternatives GW-3 and GW-4 employ technologies to prevent contaminated groundwater from discharging into HBHA Pond and also destroy or remove target contaminants from the groundwater. Alternative GW-3 is an ex-situ system while Alternative GW-4 is an in-situ design. Both technologies are able to reduce the toxicity, mobility and volume of contaminants in the groundwater and both treatment processes are irreversible.

Halls Brook Holding Area Pond Sediments (HBHA): The No Action Alternative, HBHA-1, and Alternatives HBHA-2, and HBHA-3 do not treat contaminants. Alternative HBHA-3 reduces the mobility of contaminated sediments by placing a cap over them. The Preferred Alternative, HBHA-4, and Alternative HBHA-5 may include limited off-site treatment of dredged sediments, if necessary, to qualify for disposal at a licensed landfill. HBHA-4 also reduces the mobility of contaminated sediments by creating a retention area where contaminated sediments are contained and periodically removed.

Near Shore Sediments (NS): The No Action Alternative, NS-1, and Alternatives NS-2 and NS-3 do not treat contaminants. Alternatives NS-2 and NS-3 may reduce mobility in the long-term if contaminated sediments in the Wells G&H Wetland and the Cranberry Bog Conservation Area are buried by the accumulation and deposition of uncontaminated sediments. The Preferred Alternative, NS-4, may include limited off-site treatment if necessary to qualify for disposal of excavated sediments at a landfill.

Deeper Wetland Sediments (DS): The No Action Alternative, DS-1 and the Preferred Alternative, DS-2, do not treat or reduce the toxicity of the deeper wetland sediments near the Wells G&H Wetland and the Cranberry Bog Conservation Area unless other alternatives are implemented upstream to reduce downstream contaminant migration and clean sediments are given an opportunity to accumulate and deposit on top of contaminated sediments, in essence capping the contaminated sediment. Alternative DS-3 may include limited off-site treatment, if necessary, to qualify for disposal of excavated sediments at a licensed landfill.

Surface Water (SW): The No Action Alternative, SW-1, the Preferred Alternative, SW-2, and Alternative SW-3 do not include treatment.

5. SHORT-TERM EFFECTIVENESS:

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers and the community during construction and operation of the remedy until cleanup goals are achieved.

Surface Soil (SS): The No Action Alternative, SS-1, would not be effective in the short-term or cause any short-term impacts because the alternative does not require any action. Alternatives SS-2 and SS-3, which call for the installation of institutional controls in the former Mishawum lakebed area, will effectively limit risks to human health in the short-term. In addition, the cover required as part of SS-3 will become effective upon its construction. Alternatives SS-4 and SS-5 will become effective once the contaminated soils in this area are excavated and disposed of off-site or treated. The Preferred Alternative, SS-2, would have limited impacts on property owners where institutional controls restrict land use. Alternatives SS-3, SS-4, and SS-5 would have the most short-term impacts on the community, including an increase in traffic during construction activities. Impacts to workers would be minimal since construction activities would be completed in accordance with appropriate health and safety procedures and potential risks and hazards associated with fugitive dust emissions would be addressed with prescribed engineering controls. No adverse environmental impacts are anticipated from any alternative.

Subsurface Soil (SUB): The No Action Alternative, SUB-1, would not be effective in the short-term or cause any short-term impacts because the alternative does not require any action. Alternatives SS-2 and SS-3 which call for the installation of institutional controls in the former Mishawum lakebed area will effectively limit risks to human health in the short-term. In addition, the permeable cover required as part of SS-3 will become effective upon its construction. The Preferred Alternative, SUB-2, would have limited impacts on property owners in this area where institutional controls restrict land use. Alternative SUB-3 would have the most significant short-term impacts on the community including an increase in traffic during construction activities. Impacts to individual property owners would be significant since large portions of property would require a soil cover and the use of parking areas and road ways would be temporarily restricted. Impacts to workers would be minimal since construction activities would be completed in accordance with appropriate health and safety procedures and potential risks and hazards associated with fugitive dust emissions would be addressed with prescribed engineering controls. No adverse environmental impacts are anticipated from any alternative.

Groundwater (GW): The No Action Alternative, GW-1, would not be effective in the short-term or cause any short-term impacts because the alternative does not require any action. Alternative GW-2, the Preferred Alternative, and Alternatives GW-3 and GW-4 which call for the installation of institutional controls will effectively limit risks to human health in the short-term. The Preferred Alternative, GW-2, would have limited impacts on property owners since the imposition of institutional controls would restrict groundwater use. Alternatives GW-3 and GW-4 would have limited short-term impacts on the community, including an increase in traffic during construction activities. Fugitive dust emissions would be addressed with engineering controls. Alternatives GW-3 and GW-4 may have limited adverse environmental impacts during construction, however engineering controls and approved construction methods would be used to minimize these risks.

Halls Brook Holding Area Pond Sediments (HBHA): The No Action Alternative, HBHA-1, would not be effective in the short-term or cause short-term impacts because the alternative does not require any action. Alternative HBHA-2 would not cause any short-term impacts to the community because the alternative only requires monitoring. Alternative HBHA-3, the Preferred Alternative, HBHA-4, and Alternative HBHA-5 would have the most short-term impacts on the community including an increase in traffic during construction activities. Fugitive dust emissions would be addressed with engineering controls. Alternative HBHA-3 would have potential significant environmental impacts from the displacement and migration of contaminated sediments during the placement of the cap. However, these potential risks could be minimized through engineering controls that minimize and control suspended solids. The Preferred Alternative, HBHA-4, and Alternative HBHA-5 would have the most significant short-term environmental impacts due to the dredging activities. Benthic communities destroyed during the sediment removal would re-establish themselves over time.

Near Shore Sediments (NS): The No Action Alternative, NS-1, would not be effective in the short-term or cause any short-term impacts because the alternative does not require any action. Alternatives NS-2 and NS-3 would have minor impacts on the community and workers installing protective fencing in the Wells G&H Wetland and the Cranberry Bog Conservation Area. The Preferred Alternative, NS-4, would have the most short-term impacts on the community, including an increase in traffic during construction activities as well as an increase in organic odors while excavating along shoreline wetlands. Fugitive dust emissions would be minimized and addressed with engineering controls. Alternative NS-4 would also cause short-term environmental impacts during excavation restoration of the wetland. These impacts would be minimized by engineering controls. Benthic communities destroyed during the sediment removal would re-establish themselves over time.

Deeper Wetland Sediments (DS): The No Action Alternative, DS-1, and the Preferred Alternative, DS-2, would not cause any short-term impacts to the community or on-site workers because the alternatives do not require any action. Alternative DS-3 would have the most significant short-term impacts on the community and surrounding businesses, including an increase in traffic during construction activities, as well as an increase in organic odors while excavating the deeper sediments in the Wells G&H Wetland and the Cranberry Bog Conservation Area. Impacts to individual property owners would be significant since large portions of property would be utilized to implement the alternative. Fugitive dust emissions would be minimized and addressed with engineering controls. Alternative DS-3, which requires constructing haul roads, potential cofferdams and intrusions into the wetland areas to access deep sediments, would cause extensive and severe environmental impacts. These impacts would be minimized by engineering controls during the remediation. Benthic communities and other wetland habitat features that are destroyed during sediment removal would eventually re-establish themselves over time.

Surface Water (SW): The No Action Alternative, SW-1, would not cause any short-term impacts to the community or on-site workers because the alternative does not require any action. The Preferred Alternative, SW-2, would not cause any short-term impact on the community. Alternative SW-3 would have the most short-term impacts to the community due to the construction of an alternate wetlands habitat.

6. IMPLEMENTABILITY:

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

Surface Soil (SS): The No Action Alternative, SS-1, would be the easiest to implement because there are no remedial actions required. The Preferred Alternative, SS-2, would be the next easiest to implement. Alternatives SS-3, SS-4 and SS-5 would be more difficult than the other alternatives due to the former Mishawum lakebed area requiring remediation, the proximity to active commercial and light industrial properties, and the additional construction activities associated with these alternatives.

Subsurface Soil (SUB): The No Action Alternative, SUB-1, would be the easiest to implement because there are no remedial actions. The Preferred Alternative, SUB-2, would be the next easiest to implement. Alternative SUB-3 would be more difficult than the other alternatives due to the former Mishawum lakebed area requiring remediation, the proximity to active commercial and light industrial properties, and the additional construction activities associated with this alternative.

Groundwater (GW): The No Action Alternative, GW-1, is the easiest to implement because there are no remedial actions required. The Preferred Alternative, GW-2, would be the next easiest to implement. Alternative GW-3 would be more difficult than Alternative GW-2 due to the complexities involved with a multi-process treatment system and typical construction issues. However, technologies for Alternative GW-3 are reliable and proven. Alternative GW-3 requires more extensive operation and maintenance than any other alternative and would likely require a full-time treatment plant operator. Alternative GW-4 could be the most difficult to implement due to the deep excavations required to install the reactive wall and uncertainties associated with the technology. However, these uncertainties could be addressed during the pre-design investigation.

Halls Brook Holding Area Pond Sediments (HBHA): The No Action Alternative, HBHA-1, would be the easiest to implement because there are no remedial actions required. Alternative HBHA-2 would be the next easiest since it only involves collecting sediment samples. Alternative HBHA-3, the Preferred Alternative, HBHA-4, and Alternative HBHA-5 would be more difficult than Alternatives HBHA-1 and HBHA-2 due to the construction activities involved in these alternatives, including dredging, water treatment, sediment dewatering, and the need for specialized equipment and skilled workers. The Preferred Alternative, HBHA-4, is more difficult than Alternative HBHA-5 because it is further compounded by the construction of a sediment retention area and larger compensatory wetland. All alternatives except the Preferred Alternative, HBHA-4, require that contaminated groundwater discharges be eliminated prior to constructing the remedy so that the excavated or capped areas do not become re-contaminated.

Near Shore Sediments (NS): The No Action Alternative, NS-1, would be the easiest to implement because there are no on-site remedial actions required. Alternatives NS-2 and NS-3 would be the next easiest since the only activities required are posting fences and signs in the Wells G&H Wetland and the Cranberry Bog Conservation Area. Alternative NS-3 would also include periodic sampling of surface water and sediment. The Preferred Alternative, NS-4, would be more difficult than the others due to the excavation, dewatering, water treatment and wetlands restoration activities involved in this alternative.

Deeper Wetland Sediments (DS): The No Action Alternative, DS-1, and the Preferred Alternative DS-2 would be the easiest to implement because there are no on-site remedial actions required. Alternative DS-3 would be the most difficult to complete due to the complexities involved in accessing the interior portions of the Wells G&H Wetland and the Cranberry Bog Conservation Area with heavy equipment to conduct the excavation, dewatering, water treatment and wetlands restoration activities involved in this alternative.

Surface Water (SW): The No Action Alternative, SW-1, and the Preferred Alternative, SW-2, would be the easiest to implement because there are no on-site remedial actions required. The Preferred Alternative, SW-2, would require additional effort associated with monitoring. Alternative SW-3 would be the most difficult to implement due to locating and constructing an alternate wetlands habitat.

7. COST:

The estimated present worth costs for each alternative are presented in Table K-8 (same table presented in the Proposed Plan – without the highlight). The estimated present worth costs for the alternatives addressing SS, SUB, GW, HBHA, NS, DS and SW, not including the No Action alternatives, range from $11.0 million to $215.0 million. The selected remedy includes alternatives SS-2, SUB-2, GW-2, a portion of GW-4, HBHA-4, NS-4, DS-2, and SW-2, and has a total estimated present worth cost of $25.7 million.

8. STATE ACCEPTANCE:

The State has expressed its support for the preferred alternatives presented in the Proposed Plan and concurs with the selected remedy outlined in this ROD. See Appendix A for state concurrence letter.

9. COMMUNITY ACCEPTANCE:

EPA held an informational Public Meeting on June 30, 2005, initiating a 30-day public comment period beginning July 1, 2005. In response to public requests, EPA extended this initial public comment period 30-days closing the public comment period on August 31, 2005. After review of the public comments, EPA then reopened the comment period from October 20, 2005 to November 18, 2005. EPA held Public Hearings on July 27, 2005, and November 17, 2005. EPA received extensive written and oral comments from community during this process.

Members of the public, community leaders, and environmental groups neither supported nor advocated against EPA's selected remedy. Specific comments focused on institutional controls, comprehensive long-term monitoring, wetland functions impacts, assurances the selected remedy will work, and participation in the Remedial Design and Remedial Action phases. Many comments also indicated that additional time to review the Proposed Plan and supporting technical documents (e.g. MSGRP RI, FS, technical memoranda, etc.) was needed.

L. THE SELECTED REMEDY

1. Summary of the Rationale for the Selected Remedy

The selected remedy is a comprehensive remedy which utilizes source control and management of migration components to address the principal risks at Industri-plex OU-2. The selected remedy serves as a final remedy for the Industri-plex Superfund Site, and addresses the third operable unit (OU-3, Aberjona River Study) for the Wells G&H Superfund Site. If any final groundwater decisions are necessary for the remaining Wells G&H aquifer, these decisions will be made under Wells G&H Operable Unit 2, Central Area Study.

The major components of the remedy include the following:

- Dredging and off-site disposal of contaminated sediments in the southern portion of the HBHA Pond; dredging and off-site disposal of contaminated near shore sediments at the Wells G&H Wetland and Cranberry Bog Conservation Area; and restoration of all disturbed areas. This component will address sediments posing unacceptable human health risks for near shore sediments and unacceptable ecological risks for the southern portion of HBHA Pond.

- Use of the northern portion of HBHA Pond as a sediment retention area (primary and secondary treatment cells) that will intercept contaminated groundwater plumes (including arsenic, benzene, ammonia, 1,2-dichloroethane, trichloroethene, naphthalene) from Industri-plex OU-1, treat/sequester contaminants of concern (including arsenic, benzene, ammonia), and minimize downstream migration of contaminants (including arsenic, benzene, ammonia). The primary treatment cell will intercept the contaminated groundwater plumes discharging in the HBHA Pond. The effluent from northern portion of the HBHA Pond (secondary treatment cell outlet) will serve as the surface water compliance boundary, and achieve National Recommended Water Quality Criteria (NRWQC). Sediments which accumulate in the northern portion of the HBHA Pond will be periodically dredged and sent off-site for disposal. Portions of storm water from Halls Brook, which may interfere with the natural treatment processes occurring within the northern portion of the HBHA Pond, will be diverted to the southern portion of HBHA Pond.

- If necessary, In-situ Enhanced Bioremediation of contaminated groundwater plumes (e.g., benzene) at the West Hide Pile (WHP).

- Construction of an impermeable cap to line stream channels (e.g. New Boston Street Drainway), and to prevent the discharge of contaminated groundwater plumes, contamination of stream sediments, downstream migration of contaminants of concern, and potential impacts to other components of the selected remedy.

• Construction of a permeable cap to prevent contaminated soil erosion (e.g. Area A6), downstream migration of contaminants of concern, and potential impacts to other components of the selected remedy.

• Establishing institutional controls to restrict contact with soils, groundwater, or deeper interior wetland sediments with concentrations above cleanup standards and protect the remedy.

• Construction of compensatory wetlands for any loss of wetland functions and values associated with the selected remedy (e.g. northern portion of HBHA Pond, Halls Brook storm water by-pass, capped stream channels) nearby in the watershed.

• Long-term monitoring of the groundwater, surface water, and sediments, and periodic Five-year Reviews of the remedy.

2. Description of Remedial Components

The selected remedy is consistent with EPA's preferred alternative outlined in the June 2005 Proposed Plan and is consistent with a combination of all or a portion of Alternatives SS-2, SUB-2, GW-2, GW-4 for WHP, HBHA-4, NS-4, DS-2, and SW-2, outlined in the June 2005 Feasibility Study. The selected remedy is generally depicted in Figure L-1.

<u>Soil Contamination in Former Mishawum Lakebed Area</u>

Risks from contaminated surface and subsurface soils in the former Mishawum lakebed Area, generally depicted in Figures J-1 and J-2 and mostly under buildings and bituminous parking lots and streets for surface soils, will be addressed via Institutional Controls. See "Institutional Controls" Section below for additional details.

<u>Groundwater</u>

Risks from exposure to contaminated groundwater plumes, generally depicted in Figures J-3 and J-4, will be controlled via Institutional Controls. See "Institutional Controls" Section below for additional details. Downstream migration of the contaminated groundwater to areas in the HBHA Wetlands and the Aberjona River will be controlled by intercepting the contaminated groundwater plumes at the HBHA Pond where contaminants of concern will be degraded, sequestered and/or treated such that no unacceptable human health or ecological risks are present downstream of the HBHA Pond. Additional detail on the HBHA Pond remedial component is outlined in the "Halls Brook Holding Area Pond" Section below.

In addition, benzene contamination in groundwater in the area of the West Hide Pile (WHP), generally depicted in Figure J-4 and conceptually depicted in Figure J-5, may be treated via the installation of an in-situ enhanced bioremediation system, including installation of small diameter (e.g. 2 inch) injection wells for the application of oxygenated materials to promote biological degradation. Plumes associated with the West Hide Pile (e.g. benzene, arsenic, ammonia) likely discharge to nearby wetlands (e.g. southern pond). However, additional groundwater and surface water data are required to assess the impact of groundwater discharge, originating from the West Hide Pile, on surface water and sediments. If EPA determines that there are no unacceptable risks from contaminated groundwater discharges after the collection and evaluation of additional data during pre-design studies, and institutional controls have been implemented appropriately on the property restricting human health exposures to the contaminated groundwater, then it may not be necessary to implement this enhanced bioremediation component of the remedy.

<u>Halls Brook Holding Area Pond</u>

There are six important aspects of this component of the selected remedy:

1) The northern portion of the HBHA Pond is incorporated in the selected remedy, and designed to intercept contaminated groundwater plumes from Industri-plex OU-1 and sequester/treat contaminants so that surface water discharge from the northern portion is below surface water cleanup standards (e.g. National Recommended Water Quality Criteria, benchmark criteria) for those contaminants. Sediments that accumulate in the northern portion of the HBHA Pond will be removed periodically and disposed off-site. As described in the conceptual plan below, the northern portion of the HBHA Pond will be divided into a primary and secondary treatment cell to achieve cleanup standards, comply with remedial action objectives, and not impact other components of the selected remedy;

2) Sediments in the southern portion of the HBHA Pond will be removed and restored;

3) Storm water by-pass system will be designed and constructed for storm surface water flows (e.g. Halls Brook) that may disrupt the chemocline (stratification of the heavier (greater density) contaminated deep water and lighter (lower density) shallow water) and sequestering/treatment processes within the northern portion of the HBHA Pond for this component of the selected remedy, and/or cause contamination to migrate downstream;

4) Impermeable caps will be designed and constructed to line stream channels and prevent contaminated groundwater plumes discharge into surface water (e.g. New Boston Street Drainway), downstream migration of contaminants of concern and potential impacts to other components of the selected remedy;

5) Permeable caps will be designed and constructed to prevent contaminated soil erosion (e.g. Area A6), downstream migration of contaminants of concern, and potential impacts to other components of the selected remedy; and

6) Wetland and water function and value losses (e.g. northern portion of the HBHA Pond, stormwater by-pass system, capped areas) will be compensated nearby in the watershed.

The location of this component of the selected remedy is generally depicted in Figure J-6, and some of above aspects of this component are conceptually depicted in Figure J-7.

This component of the selected remedy divides the HBHA Pond into two major portions (i.e. northern and southern portions). While the specific design and layout of this portion of the remedy will be determined during the Remedial Design, the following is EPA's conceptual plan based on the evaluation conducted in the Feasibility Study: Two low-head cofferdams will be constructed in the northern portion of the HBHA Pond which will subdivide the northern portion into two treatment areas or cells (i.e. primary and secondary treatment cells). The northern portion of the HBHA Pond will capture the discharge of the contaminated groundwater plumes (exceeding the groundwater cleanup standards), sequester/treat contaminants to achieve surface water cleanup standards (i.e. surface water component of the remedy), serve as a sediment retention area requiring period dredging, and prevent the migration of contaminated sediment and surface water downstream. The sediments in the southern portion of the HBHA Pond exceeding sediment cleanup standards will be dredged and disposed off-site at a permitted facility, and the southern portion will be restored. Implementation of the dredging measures associated with the southern portion of the HBHA Pond dredging would likely resemble similar measures outlined below under Section L "Aberjona River Sediments", and possibly include mechanical and/or hydraulic dredging measures.

The two low-head cofferdams (northern/first and southern/second cofferdams), which divide the northern portion of the HBHA Pond, will create the primary and secondary treatment cells. The primary treatment cell and the first low-head cofferdam will intercept contaminated groundwater plumes discharging into the HBHA Pond, sequester/treat the discharge of the groundwater plumes through natural processes, maintain the chemocline within the primary treatment cell at least 100 centimeters below the elevation of the top of the first low-head cofferdam, and serve as sediment retention area. The secondary treatment cell and the second low-head cofferdam includes an aeration treatment system designed to treat surface water from the primary treatment cell and further sequester/treat contaminants of concern (including arsenic, ammonia and benzene). The secondary treatment cell will also serve as a sediment retention area. The outlet of the secondary treatment cell (i.e. second low-head cofferdam) will comply with surface water cleanup standards (e.g. National Recommended Water Quality Criteria, surface water benchmarks), and remedial action objectives. Sediments that accumulate in the northern portion of the HBHA Pond (primary and secondary treatment cells) will be removed periodically and disposed off-site at a permitted facility. Periodic removal will be necessary to prevent excessive accumulation of sediments, and maintain the integrity of the chemocline and the function of the primary and secondary treatment cells. The dredging measures associated with the sediment retention areas of the primary and secondary treatment cells may include hydraulic dredging measures.

In addition to other design and performance criteria that will be detailed in the remedial design, EPA is establishing the following conditions that may trigger dredging in the northern portion of the HBHA Pond (primary and/ or secondary treatment cells): 1) if the chemocline rises to within 100 cm of the top of the primary treatment cell low-head cofferdam (first cofferdam) outlet, or 2) concentrations of surface water effluent/ outlet from the second treatment cell low-head cofferdam (second cofferdam) exceed the surface water cleanup standards. However, EPA expects that other cost effective interim measures will be evaluated and possibly implemented prior to implementing dredging activities at the HBHA Pond. These interim steps (for example, actions other than dredging) may temporarily postpone the need for dredging operations, until the interim steps are no longer effective and excessive sediment accumulation within primary and/or secondary treatment cells requires dredging. Frequent long-term monitoring will be necessary to monitor the system.

A portion of the sediments in the HBHA Pond help maintain the supply of ferrous iron that contributes to the capture of arsenic near the chemocline and promote microbial degradation, which suggests that when dredging becomes necessary in the primary treatment cell, only partial dredging should be implemented sufficient to lower the elevation of the chemocline and/ or provide further sediment retention capacity. Also, dredging should only be implemented when necessary to ensure that the remedy is functioning appropriately, achieving the remedial action objectives and standards, and the chemocline remains below a depth of 100 cm in the water column ensuring no elevated releases of contaminants of concerns downstream. Long-term groundwater monitoring will also be included as part of the comprehensive monitoring program to evaluate groundwater conditions upgradient, cross-gradient and downgradient of the HBHA Pond.

This component also includes a storm water by-pass system for Halls Brook, impermeable capping of sediments, and permeable capping of soils that may cause downstream migration of contamination and/or may impact the components of the selected remedy.

A storm water by-pass system will be designed and constructed to divert a portion of storm flow from Halls Brook and avoid disrupting the treatment properties of the northern portion of the HBHA Pond (primary and secondary treatment cells)/sediment retention system, including the chemocline. A portion of stormwater flow that would otherwise enter the northern portion of the HBHA Pond and cause destabilization of the chemocline and/or sediment erosion would instead be diverted to the southern portion of the HBHA Pond (downstream of the secondary treatment cell), so that base flow conditions are maintained in the primary and secondary treatment cells during storm events, and the chemocline remains stabilized in the primary treatment cell. This action will help prevent downstream migration of contaminants of concern and potential impacts to other components of the selected remedy.

An impermeable cap will be placed along stream channels (e.g. portions of the New Boston Street Drainway) to prevent contaminated groundwater plumes (e.g. arsenic) discharge, downstream migration of contaminants of concern and potential impacts to other components of the selected remedy. A permeable cap will be placed along contaminated soils (e.g. the northern banks of the HBHA Pond along the southern boundary of the Boston Edison right-of-way and adjacent to the railroad right of-way west of the HBHA Pond (e.g., Area A6)) to prevent soil erosion (i.e. soils exceeding the sediment cleanup standards), additional loading of contaminated sediments to the primary and secondary treatment cells, downstream migration of contaminants of concern, and potential impacts to other components of the selected remedy.

Any wetland function and value losses associated with the selected remedy will be compensated for within the watershed including the northern portion of the HBHA Pond being used as component of the selected remedy, construction of the storm water bypass system and capping sediment/soil areas.

The components of the selected remedy for the HBHA Pond (i.e. HBHA-4), will receive continuous contaminated groundwater discharges for the foreseeable future, and the remedial design for these components must take into consideration significant storm weather conditions (including hurricanes) to ensure durability, permanence, and long term performance.

The details of this component of the selected remedy will be established during pre-design investigations and remedial design, and many of the components are inter-dependent. For example: The location of the first low-head cofferdam and size of the primary treatment cell will greatly depend upon pre-design investigations to further delineate the extent of the contaminated groundwater plumes' discharge into the HBHA Pond so that the primary treatment cell captures all of the contaminated groundwater plumes. The locations of the first low-head cofferdam, the size of the primary treatment cell and the design of the secondary treatment cell will directly affect other remedy components such as the length/size of the Halls Brook storm water by-pass system, the size of the southern portion of the HBHA Pond requiring dredging and restoration, and the amount of wetlands compensation. Also, the wetland function losses associated with the construction of impermeable and permeable caps will affect the amount of wetlands compensation.

Aberjona River Sediments

This component of the selected remedy addresses risks to humans from exposures to contaminated near-shore sediments in the Wells G & H Wetland and the Cranberry Bog Conservation Area by removing near-shore contaminated sediments exceeding the soil cleanup standards, restoring the near shore area, and dewatering and disposing of the contaminated sediments off-site at an approved licensed facility. The general locations of the near-shore areas requiring excavation are depicted on Figure J-8.

Implementation of this remedy component would likely include measures to prevent downstream migration of sediments during construction; dewatering of area proposed for excavation (as necessary) and excavated materials, and treatment of resulting water; installing low-head cofferdams or other means to hydraulically isolate excavation areas from the open water portions of the wetland; replacing wetland substrate and vegetation that was removed; and restoring all areas impacted during construction. During design, proposed construction methods, access points, and haul routes will be discussed and coordinated with local officials to ensure that adverse impacts on the community during construction are minimized.

Risks from contamination in deeper wetland sediments (in areas generally depicted on Figure J-9) will be addressed via institutional controls and long-term monitoring. See "Institutional Controls" Section below for additional details.

The selected remedy may change somewhat as a result of the remedial design and construction processes. Changes to the remedy described in this Record of Decision will be documented in a technical memorandum in the Administrative Record for the Site, an Explanation of Significant Differences or a Record of Decision Amendment, as appropriate.

Remedial Design and Pre-Design Studies

A number of additional investigations may be necessary to provide additional detailed information required to implement the selected remedy. Pre-design studies may include:

- investigation to delineate the limits of contamination requiring remediation in areas of accessible sediments. Accessible sediments were defined in Appendix 6A of the March 2005 MSGRP RI as areas with mild to moderate vegetation, generally shallow (i.e., less than two feet) and slow moving surface water, and gradual banks with few, if any, physical barriers present (e.g., fencing or other access obstacles). Figure J-8 illustrates the approximate location for accessible near shore sediments exceeding sediment cleanup standards to be removed. Pre-design investigations may be implemented to further estimate the areas requiring removal;

- investigations to further delineate the limits of contamination requiring institutional controls and evaluate background groundwater conditions for ammonia, as well as pre-design groundwater, surface water and sediment investigations at/near the West Hide Pile, East Hide Pile and adjacent wetlands (e.g. benzene, arsenic, ammonia) for assessing potential human health and ecological risks;

- any necessary studies to support the design and implementation of institutional controls approved by EPA;

- studies to locate property suitable for the construction of a compensatory wetlands to mitigate wetland and water function and value losses;

- investigation of the contaminated groundwater plumes and where they discharge into the HBHA Pond so that placement of the first low-head cofferdam for the primary treatment cell can be appropriately located and capture the groundwater plumes (e.g. arsenic, benzene, ammonia); and,

- investigations regarding the design and construction of the primary and/ or secondary treatment cells in the HBHA Pond, including flood storage and mitigation.

Also, as prescribed by EPA guidance, both HHRAs were prepared to evaluate a reasonable maximum exposure (RME) case. The risk assessment was also prepared to account for future potential exposure pathways, as required by EPA guidance, since those hypothetical future exposure pathways may not be completely controllable. Until institutional controls are fully implemented, those future pathways are considered potentially complete, and knowledge of the potential risk findings associated with those pathways are important to the risk management process.

The site-specific arsenic bioavailability study was performed to be specifically applicable to sediment, not soil. Because the soil matrix composition and structure could differ considerably from that of sediment, the arsenic bioavailability estimate developed for sediment was not considered applicable to the soil ingestion pathway. However, during pre-design, additional site-specific, EPA-approved studies/tests may be conducted to determine the relative bioavailability of arsenic from surface soils, or from subsurface soils, if such an approach is deemed beneficial in limiting the extent of institutional controls that may be necessary for individual properties. EPA-approved studies/tests include in-vivo bioavailability studies (e.g. swine bioavailability study) similar to the study conducted by EPA during the MSGRP RI. Future EPA-approved studies may potentially include in-vitro bioavailability studies (not currently approved by EPA).

Individual studies must be conducted for surface soils and subsurface soils (samples from both samples may not be consolidated into one sample because of likely variability in the soil matrix).

The selected remedy is necessary to remove the high concentrations of benzene from the West Hide Pile. Pre-design investigations will be necessary to further evaluate the West Hide Pile and East Hide Pile contaminated groundwater plumes' impact on the nearby wetlands and downgradient groundwater plumes. Institutional controls required under the 1986 Record of Decision have not been recorded on any property to date. However, if 1) appropriate pre-design investigations are implemented for groundwater, surface water and sediment at/near the West Hide Pile, East Hide Pile and adjacent wetlands (e.g. benzene, arsenic, ammonia); 2) EPA further evaluates this data and determines there are no unacceptable ecological or human health risks (exceeding the cleanup standards established for this remedy); and, 3) institutional controls are put in place and eliminate the groundwater human health risks, the implementation of the enhanced bio-remediation remedy for the West Hide Pile may not be necessary.

The specific details of the design and implementation of the selected remedy outlined in this ROD will be finalized during the Remedial Design phase, and will depend on the results of the various pre-design investigations outlined above. The final design of the HBHA Pond remedy may differ somewhat from the conceptual layout of the two low-head cofferdam system described for the HBHA Pond.

Institutional Controls

In order to protect human health by controlling potential exposures to contaminated soils, sediments, and groundwater, the selected remedy relies on the use of Institutional Controls such as limitations on land and groundwater uses and activities. Institutional Controls are also necessary for the protection of the selected remedy. The details of the institutional controls will be resolved during the pre-design and remedial design phase in coordination with the parties performing the Remedial Action, impacted landowners, and local officials. MassDEP participation with the Institutional Controls will be in accordance with Commonwealth of Massachusetts policies, guidance and regulations.

Risks from exposure to contaminated groundwater will be controlled through the implementation of institutional controls. In areas where groundwater contamination exceeds the performance standards outlined in Table L-1, groundwater use restrictions will be required for drinking water, industrial process water, or other purposes (such as waster for a commercial car wash facility and groundwater encountered during excavation activities).

Risks from exposure to contaminated surface (0' - 3' below ground surface) and sub-surface (3' – 15' below ground surface) soils in the former Mishawum lakebed area will be controlled through the implementation of institutional controls. In areas where surface or sub-surface soil contamination exceeds the cleanup standards outlined in Table L-2, land use restrictions will be required to restrict excavations without adequate worker health and safety precautions (e.g. engineering controls, personal protective equipment (PPE), monitoring, etc) to minimize or prevent direct contact with contaminated soil during removal activities, and restrict potential on-site and off-site spread of contamination. Furthermore, on properties where surface soils exceed the cleanup standards, it will also be necessary to restrict land use so that child care facilities are not constructed in those areas.

The selected remedy will address risks to humans from future exposures to sediments situated deeper into the Wells G & H Wetland and the Cranberry Bog Conservation Area wetlands by dredging workers through the use of institutional controls in areas where sediment contamination exceeds the cleanup standards. The details of these institutional controls will be resolved during the remedial design phase. Generally, these sediments are not accessible to humans except in a future dredging scenario. Therefore, prohibitions or restrictions on dredging would be an effective deterrent to potential future exposures to sediment in the deep sediment human health risk areas. Institutional controls would prohibit dredging in areas where sediment contamination exceeds the cleanup standards outlined in Table L-4 unless regulatory oversight and adequate precautions (e.g. engineering controls, PPE, etc.) were taken to minimize or prevent direct contact with contaminated sediment during dredging activities.

Institutional Controls will also be required to ensure that any remedial components constructed as part of the selected remedy, such as covers or caps over contaminated soils areas or low-head cofferdams or other structures constructed in or near the HBHA Pond as part of the remedy are not disturbed or otherwise compromised by any other use or activity.

<u>Long-term Monitoring and Five-year Reviews</u>

Long-term monitoring of groundwater, surface water, and sediments will be required in order to evaluate contaminant status and migration.

Groundwater monitoring is included to ensure that contaminated soils that are left in place do not impact groundwater and do not create unacceptable human health risks in the future. Groundwater monitoring wells will be installed to evaluate contaminant trends and human health and ecological risks or hazards. Details of groundwater monitoring will be resolved during design and the preparation of a long-term monitoring plan. Monitoring scope and frequency could change over time. If contaminant trends show that there have been no impacts to groundwater such that no human health risks or hazards have been created, then groundwater sampling would be suspended or discontinued. If concentrations are shown to increase or persist, then monitoring will continue. Monitoring will also be performed to evaluate the performance of the selected remedy.

Since wastes will be left in place as part of the selected remedy, the NCP requires periodic reviews of the remedy. A comprehensive review will be conducted at least every five years to evaluate the protectiveness of the remedy. The purpose of this Five-year Review is to evaluate the implementation and performance of the remedy in order to determine if the remedy is or will be protective of human health and the environment. The Five-year Review will document recommendations and follow-up actions as necessary to ensure long-term protectiveness of the remedy or bring about protectiveness of a remedy that is not protective. These recommendations could include providing additional response actions, improving O&M activities, optimizing the remedy, enforcing access controls and institutional controls and conducting additional studies and investigations.

The selected remedy also includes long-term operation, inspections, and maintenance of any systems put in place as part of the remedy, including caps and/or covers over contaminated soils areas, low-head cofferdams, primary and secondary treatment cells, and storm water by-pass structures; periodic removal of accumulated sediments from the sediment retention portion of the HBHA Pond. Long-term inspections and monitoring will also be required to ensure that institutional controls remain effective and are being enforced, and, long-term monitoring of groundwater, surface water, sediments and biota will be necessary to evaluate the effectiveness and re-colonization of biota in the dredged area, as well as the effectiveness of any revegetation, wetland restoration, or wetland replication area.

Long-term monitoring of the northern portion of the HBHA Pond is necessary to evaluate its sequestering/ treatment effectiveness and performance, as well as the chemocline (continued stratification of contaminated water based on higher density water with higher salt content). Although a comprehensive, EPA-approved monitoring program will be developed during the design phase, this monitoring will likely include, at a minimum, the installation and monitoring of sampling stations at discrete sample depths (e.g. sampling intervals 25 cm to 50 cm apart) in the northern portion and monitor for contaminants of concern, specific conductance, dissolved oxygen, ferrous iron (filtered), total iron (unfiltered). The plan will also include sediment accumulation monitoring within the northern portion of the HBHA Pond (primary and secondary treatment cells).

It will also be necessary to monitor the performance of the selected remedy at Industri-plex OU-2 and downstream along the Aberjona River and Mystic Lakes. An EPA-approved monitoring program will be developed during the design phase and will include, at a minimum, surface water monitoring at the HBHA Pond and monitoring along the series of surface water monitoring stations at Industri-plex OU-2, and downstream along the Aberjona River and Mystic Lakes. The monitoring shall also include a component of periodic sediment monitoring within Industri-plex OU-2 boundaries (e.g. wetlands near West Hide Pile, HBHA, Wells G&H Wetlands, Cranberry Bog Conservation Area) and Upper Mystic Lakes including the upper and lower forebays.

The June 2005 Feasibility Study and June 2005 Proposed Plan evaluated monitoring requirements for each alternative to compare costs. However, it is likely that the long-term monitoring requirements of each component of the selected remedy may be consolidated under one Operations and Maintenance Plan for the Remedial Action per this ROD.

3. Summary of the Estimated Remedy Costs

All cost information reported in the ROD is from estimates from the Industri-plex OU-2 MSGRP FS, with an accuracy expectation of +50% to -30%. These estimates will be refined as the remedy is designed and implemented. The original estimated cost of the components of the selected remedy as illustrated in Tables 4-2 (SS), 4-7 (SUB-2), 4-10 (GW-2), 4-12 (portion of GW-4 as highlighted in Table 4-29 of the Proposed Plan), 4-16 (HBHA-4), 4-21 (NS-4), 4-23 (DS-2), and 4-26 (SW-2) is as follows:

SS-2: Institutional Controls with Monitoring	$600,000
SUB-2: Institutional Controls with Monitoring	$1,276,000
GW-2: Pond Intercept with Monitoring and Institutional Controls	$3,918,000
GW-4 (portion representing In-situ Enhanced Bioremediation at the West Hide Pile)	$3,752,000
HBHA-4: Storm Water Bypass and Sediment Retention with Partial Dredging and Providing an Alternate Habitat	$9,187,000
NS-4: Removal and Off-Site Disposal	$3,247,000
DS-2: Monitoring with Institutional Controls	$459,000
SW-2: Monitoring	$3,226,000
Total	$25,665,000

The total cost of the components of the selected remedy is $25,665,000, based upon the present value of 30 years of Operation and Maintenance with a 7% discount rate for calculating total present worth costs. The cost estimate does not forecast beyond the 30 year time period. However, operation and maintenance costs will extend indefinitely beyond the 30 year period.

The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the Administrative Record file, an ESD, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

4. Expected Outcomes of the Selected Remedy

The expected outcome of the selected remedy is that:

- Contaminated surface soil areas (generally depicted on Figure J-1) will no longer present an unacceptable risk to children or construction workers via dermal contact and ingestion of surface soils (0' – 3' below ground surface);

- Contaminated sub-surface soil areas (generally depicted on Figure J-2) will no longer present an unacceptable risk to construction workers via dermal contact and ingestion of sub-surface soils (3' – 15' below ground surface);

- Areas of contaminated groundwater (generally depicted on Figures J-3 and J-4) will no longer present an unacceptable risk to commercial and construction workers human receptors via dermal contact, ingestion and inhalation of groundwater;

- Sediments in the southern portion of the HBHA Pond (generally depicted on Figure J-6) will no longer present an unacceptable ecological risk to aquatic life;

- near-shore sediment areas (generally depicted on Figure J-8) will no longer present an unacceptable risk to children and adults for ingestion and dermal contact of near shore sediments;

- deep sediment contamination areas (generally depicted on Figure J-9) will no longer present an unacceptable risk to dredging workers for ingestion and dermal contact of deeper wetland sediments; and

- Surface water areas (generally illustrated on Figure J-6) will no longer present an unacceptable risk to aquatic life in the southern portion of the HBHA Pond.

Mitigating these risks will ensure that the areas are suitable for industrial, commercial and recreational land uses. The selected remedy will also intercept contaminated groundwater plumes at the northern portion of the HBHA Pond, treat/sequester contaminants of concerns within the northern portion of the HBHA Pond (primary and secondary treatment cells), reduce migration of contamination downstream of the northern portion of the HBHA Pond, and improve the surface water quality in the watershed downstream of the northern portion of the HBHA Pond (primary and secondary treatment cells).

Based upon the June 2005 Draft Technical Memorandum – Model Simulation of Flow, Suspended Sediment, and Heavy Metal Transport for the Aberjona Watershed, it is anticipated that the contaminant migration from the northern portion of the HBHA Pond will be reduced by

90%. It is estimated that it will take two years to complete construction of the selected remedy, after the completion of pre-design investigations and final designs. The selected remedy will also provide environmental and ecological benefits such as the restoration of wetlands, and the construction of compensatory wetlands in the watershed for loss of habitat, function, and value associated with selected remedy.

a. Cleanup Standards

1. Ground Water Performance Standards

Performance Standards have been established for groundwater for all chemicals of concern identified in the Baseline Risk Assessment found to pose an unacceptable risk to either public health or the environment. These standards have been set based on the risk associated with industrial water usage, as described below, because groundwater at Industri-plex OU-1 south to Interstate 95 within the Industri-plex OU-2 MSGRP RI Northern Study Area is considered by MassDEP to be of "low use and value" and not suitable for potable use.

MassDEP completed a Ground Water Use and Value Determination for the Industri-plex aquifer Industri-plex OU-1 south to Interstate 95 within the Industri-plex OU-2 MSGRP RI Northern Study Area. This determination is attached as Appendix F. The Industri-plex aquifer was classified by MassDEP as a Non-Potential Drinking Water Source Area. This finding indicates that the groundwater beneath this portion of the Site is of low use and value as a future drinking water supply because of its concentrated industrial development, and therefore drinking water standards, consistent with the use and value determination, shall not be required to be attained in the groundwater at this portion of the Site.

Because federal and state drinking water standards are not required to be attained at this portion of the Site, a performance standard was derived for each chemical of concern having carcinogenic potential (Classes A, B, and C compounds) to be within the 10^{-4} to 10^{-6} cancer risk range considering the future incidental ingestion of, dermal contact with, and inhalation of volatile compounds released during industrial water usage (i.e., process water or car wash scenarios). Performance Standards for chemicals of concern based on non-carcinogenic effects were established based on a level that represent an acceptable exposure level to which the human population including sensitive subgroups may be exposed without adverse affect during a lifetime or part of a lifetime, incorporating an adequate margin of safety (hazard quotient = 1) considering the future incidental ingestion of, dermal contact with, and inhalation of volatile compounds released during industrial water usage (i.e., process water or car wash scenario) and worker excavation activities.

Table L-1 presents the Performance Standards for carcinogenic and non-carcinogenic chemicals of concern identified in groundwater and are summarized below.

SUMMARY OF GROUNDWATER PERFORMANCE STANDARDS	
Arsenic	150 μg/L
Benzene	4 μg/L
1,2-Dichloroethane	2 μg/L
Trichloroethene	1 μg/L
Naphthalene	5 μg/L
Ammonia	4000 μg/L

Institutional Controls will be required to restrict unacceptable exposures to groundwater that exceeds these Performance Standards.

2. Soil Cleanup Standards

Land use in the vicinity of the former Mishawum lakebed area is commercial/industrial. A day care facility was formerly located in this area and there is a high likelihood that commercial/industrial use of this area will continue, possibly including the future siting of a day care facility. Refer to Sections E and F of the ROD for more detailed descriptions of Site features and land use.

Soil cleanup standards for arsenic in surface and subsurface soil (0 to 15 feet bgs) within the former Mishawum lakebed have been established to be protective for exposure by a future day care child and an excavation worker. The soil cleanup standard for arsenic, a Class A carcinogenic compound, has been set within the 10^{-4} to 10^{-6} cancer risk range considering exposures via dermal contact and incidental ingestion. The cleanup standard for arsenic in soil is based on non-carcinogenic effects, derived for the same exposure pathway(s) and correspond to an acceptable exposure level to which the human population (including sensitive subgroups) may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety (hazard quotient = 1). Exposure parameters for the ingestion and dermal contact exposure pathways for the day care child have been described in Section G1.

Table L-2 presents the cleanup standards for arsenic in soil protective of direct contact with soil and are summarized below.

SUMMARY OF SOIL CLEANUP STANDARDS	
Arsenic	50 mg/kg

This soil cleanup standard attains EPA's risk management goal for remedial actions and have been determined by EPA to be protective. Institutional Controls will be required to restrict unacceptable exposure to contaminated soil that exceeds these Cleanup Standards

A site-specific arsenic bioavailability study was performed specifically for depositional sediments, not soil. Because the soil matrix composition and structure could differ considerably from that of sediment, the arsenic bioavailability estimate was not considered applicable to the soil ingestion pathway. However, with EPA approval, during pre-design, additional site-specific bioavailability studies may be conducted to determine the bioavailability of arsenic from surface soils or from subsurface soils, if such an approach is deemed beneficial in limiting the extent of institutional controls that may be necessary for individual properties. Individual studies must be conducted for both surface soils and subsurface soils (samples from both samples may not be consolidated into one sample because of likely variability in the soil matrix). Should a site-specific surface soil and/or subsurface soil arsenic bioavailability study be approved and performed, Table L-3 provides the formula and exposure assumptions that will be used to calculate a surface soil or subsurface soil arsenic cleanup standard, adjusted for the site-specific bioavailability of arsenic.

3. Sediment Cleanup Standards

Sediment cleanup standards protective of human health have been established for arsenic and/or benzo(a)pyrene in near-shore sediments at the Cranberry Bog Conservation Area (e.g. Stations CB-03) and Wells G&H Wetland (e.g. WH, NT-3, and 13/TT-27), generally depicted in Figure F-8, exhibiting an unacceptable cancer risk and hazard index for a future recreational user. A sediment cleanup standard for arsenic in deeper interior wetland sediments at HBHA Wetland (e.g. sediment core SC02) and Wells G&H Wetland (e.g. sediment cores SC05, SC06, and SC08), generally depicted in Figure J-9, exhibiting an unacceptable hazard index for a future dredging worker has been established such that it is protective of human health. Sediment cleanup standards for known and suspect carcinogenic chemicals of concern (Classes A, B, and C compounds) have been set within the 10^{-4} to 10^{-6} cancer risk range considering exposures via dermal contact and incidental ingestion for each receptor. Cleanup standards for chemicals of concern in sediment based on non-carcinogenic effects were derived for the same exposure pathway(s) and correspond to an acceptable exposure level to which the human population (including sensitive subgroups) may be exposed without adverse affect during a lifetime or part of a lifetime, incorporating an adequate margin of safety (hazard quotient = 1). Exposure parameters for the ingestion and dermal contact exposure pathways for the recreational user and dredging worker have been described in Section G1. Because the cleanup value described above for benzo(a)pyrene is below a background value for this compound, a background value was used for the sediment cleanup standard.

Table L-4 presents the cleanup standards for carcinogenic and non-carcinogenic chemicals of concern in sediment within the HBHA Wetland, Wells G&H Wetland, and Cranberry Bog Conservation area protective of direct contact with sediment for recreational and worker receptors.

For the HBHA Pond, a sediment cleanup standard for arsenic has been established for ecological protection of the benthic invertebrate population in the portions of the pond where toxicity testing indicated significant adverse impacts on survival and growth, and community impairment. The cleanup standard for the HBHA Pond (273 mg/kg arsenic; see Table G28) is set at a level corresponding to the lowest observed effects level for benthic invertebrates for survival and/or growth exposed to HBHA Pond sediments.

Sediment cleanup standards are summarized below.

SUMMARY OF SEDIMENT CLEANUP STANDARDS	
Near Shore Cranberry Bog Conservation Area (e.g. CB-03)	
Arsenic	230 mg/kg
Near Shore Wells G&H Wetland (e.g. WH, NT-3, 13/TT-27)	
Arsenic	300 mg/kg
Benzo(a)pyrene	4.9 mg/kg
Deeper Interior HBHA Wetland and Wells G&H Wetland (e.g. SC02, SC05, SC06, SC08)	
Arsenic	300 mg/kg
HBHA Pond (ecological)	
Arsenic	273 mg/kg

These sediment cleanup standards must be met at the completion of the remedial action at the points of compliance as follows:

- The compliance point for near shore sediments at the Wells G&H Wetland is identified as the areas targeted for excavation that currently exceed the sediment cleanup standard extending up to 30 feet from the shore line (generally east/west direction) into the wetlands and continuing laterally (generally north/south direction) until the sediment cleanup standard is achieved based upon confirmation samples analyzed for metals and SVOCs using the most recent version of EPA-approved analytical methods.

- The compliance point for near shore sediments at the Cranberry Bog Conservation Area is identified as the areas targeted for excavation that currently exceed the sediment cleanup standard primarily along the drainage swales and continuing until the sediment cleanup standard is achieved based upon confirmation samples analyzed for metals using the most recent version of EPA-approved analytical methods.

- The compliance point for deeper interior wetland sediments at the HBHA Wetlands and Wells G&H Wetlands is identified as the areas targeted for potential future dredging projects that currently exceed the sediment cleanup standard for arsenic. The approximate location of the HBHA Wetlands and Wells G&H Wetlands are presented on Figure J-9 and other figures in the MSGRP RI and FS.

- The compliance point for sediments at the southern portion of the HBHA Pond is identified as the areas for excavation that currently exceed the sediment cleanup standard and continuing until the sediment cleanup standard is achieved based upon confirmation samples analyzed for metals using the most recent version of EPA-approved analytical methods. The approximate boundaries of the HBHA pond are illustrated in Figure J-6 and other figures presented in the MSGRP RI and FS. However, the boundaries of the area of sediment to be remediated in the southern portion of the HBHA Pond will not be determined until the location of the low-head cofferdams is determined.

- The compliance point for the impermeable cap is identified as the area of the stream channel (e.g., New Boston Street Drainway) where contaminated groundwater plumes discharge into the channel, contaminate sediments, and potentially migrate downstream, impacting components of the selected remedy (including the remediated Southern Portion of the HBHA Pond).

- The compliance point for the permeable cap is identified as the area where contaminated soils above the HBHA Pond sediment cleanup standard for arsenic (e.g., Area A6) and may erode and migrate downstream impacting components of the selected remedy (including the Northern Portion of the HBHA Pond)).

The sediment cleanup standards attain EPA's risk management goals for remedial action and are protective of human health and the environment.

4. Surface Water Cleanup Standards

For the HBHA Pond, surface water cleanup standards for arsenic, ammonia, and benzene have been established for ecological protection of aquatic life from direct exposure to surface water based on exceedances of effects-based water quality criteria. These cleanup standards are presented below and in Table G-28.

SUMMARY OF SURFACE WATER CLEANUP STANDARDS

Arsenic	150 ug/L
Benzene	46 ug/L
Ammonia (temperature and pH dependent)	NRWQC

The surface water cleanup standard for arsenic (150 μg/L) is set at the NRWQC-CCC (chronic criterion) value (EPA 2002). The surface water cleanup standard for ammonia is set at the NRWQC-CCC (chronic criterion) value for Fish Early Life Stages Present and is a 30-day average concentration of total ammonia nitrogen (in mg N/L), not to be exceeded more than once every three years on average. Since the toxicity of ammonia varies depending on water temperature and pH, the ammonia NRWQC-CCC value is adjusted for temperature and pH in accordance with EPA's *1999 Update of Ambient Water Quality Criteria for Ammonia;* dated December 1999 (EPA Document No. EPQ-822-R-99-014). The cleanup standard for benzene (46 ug/l) for the HBHA Pond is set at the Water Quality values calculated using Great Lakes Water Quality Initiative Tier II methodology (Tier II benchmark value).

These surface water cleanup standards must be met at the completion of the remedial action at the point of compliance, which is defined as the discharge point of the final/furthest downstream low-head cofferdam (secondary treatment cell outlet). These cleanup standards are consistent with ARARs for surface water, attain EPA's risk management goals for remedial action, and are protective of the environment.

M. STATUTORY DETERMINATIONS

The remedial action selected for implementation at Industri-plex Superfund Site Operable Unit 2 (and including Wells G&H Superfund Site Operable Unit 3, Aberjona River Study), is consistent with CERCLA and, to the extent practicable, the NCP. The selected remedy is protective of human health and the environment, will comply with ARARs and is cost effective. In addition, the selected remedy utilizes permanent solutions and alternate treatment technologies or resource recovery technologies to the maximum extent practicable, and satisfies the statutory preference for treatment that permanently and significantly reduces the mobility, toxicity or volume of hazardous substances as a principal element.

1. The Selected Remedy is Protective of Human Health and the Environment

The remedy at Industri-plex OU-2 will adequately protect human health and the environment by eliminating, reducing or controlling exposures to human and environmental receptors through treatment, engineering controls and institutional controls. More specifically:

- Alternatives SS-2 and SUB-2 (Institutional Controls with Monitoring) protect human health by controlling potential exposures to contaminated soil through the implementation of institutional controls, whereby use of the properties for a day care facility would not be allowed (for Alternative SS-2 only), excavations would be restricted, and excavations without adequate worker health and safety precautions would be prohibited. Groundwater monitoring ensures that the contaminated soils left in place do not impact groundwater and create unacceptable human health risks in the future.

- Alternative GW-2 (Pond Intercept with Monitoring and Institutional Controls) protects human health by preventing or controlling potential exposures to contaminated groundwater through institutional controls. In addition, a portion of Alternative GW-4 (In-Situ Groundwater Treatment) addresses benzene contamination at the West Hide Pile by enhanced bioremediation until it meets site-specific cleanup goals protective of human health.

- Alternative NS-4 (Removal and Off-Site Disposal) will protect human health through the removal of near-shore sediments in the Wells G&H Wetland and the Cranberry Bog Conservation Area containing arsenic in excess of site-specific cleanup goals protective of human health. For the deeper wetland sediments in these areas, Alternative DS-2 (Institutional Controls) will protect human health by controlling potential exposures to contaminated sediments in currently inaccessible areas through the implementation of institutional controls whereby excavations would be restricted and excavations without adequate worker health and safety precautions would be prohibited.

- Alternative HBHA-4 (Storm Water Bypass and Sediment retention with Partial Dredging and Provide an Alternate Habitat) will protect the environment by the removal of contaminated sediments in the southern portion of the pond (i.e., restoration area) to meet clean-up goals protective of the environment and the construction of a compensatory wetland to mitigate the wetlands lost in the northern portion of the pond.

- Alternative HBHA-4 and GW-2 will provide protection of the environment by intercepting contaminated groundwater, maintaining the chemocline to treat and sequester contaminants in the deep portions of the pond (primary treatment cell), and further treating/sequestering contaminants at the secondary treatment cell to achieve surface water cleanup standards at the outlet of the secondary cell. These actions will reduce concentrations of contaminants in surface water entering the southern portion of HBHA Pond and other downstream areas to meet clean-up goals and ARARs protective of the environment.

These alternatives will provide additional protection of human health by controlling the downstream migration of contamination and preventing the recontamination of areas addressed by Alternative NS-4. Alternative SW-2 (Monitoring) provides for long-term monitoring of surface water, sediment, and groundwater to evaluate the effectiveness of the remedy and the long-term protection of human health and the environment afforded by the remedy. In addition, any wetland function losses resulting from implementation of the remedy will be mitigated.

The selected remedy will reduce potential human health risk levels such that they do not exceed EPA's acceptable risk range of 10^{-4} to 10^{-6} for incremental carcinogenic risk and such that the non-carcinogenic hazard is below a level of concern [i.e., no target organ HI will exceed 1]. It will reduce potential human health risk levels to protective ARARs levels, i.e., the remedy will comply with ARARs and To Be Considered (TBC) criteria. The selected remedy will provide adequate protection of the environment by addressing unacceptable ecological risk to aquatic organisms in HBHA Pond from exposures to sediment through the removal of contaminated sediments in the southern portion of the pond, and the construction of a compensatory wetland to mitigate the wetland functions and values lost in the northern portion of the pond. In addition, risk from exposures of aquatic receptors to surface water contaminants will be reduced to protective levels. Implementation of the selected remedy will not pose any unacceptable short-term risks or cause any cross-media impacts.

2. The Selected Remedy Complies With ARARs

The selected remedy will comply with all federal and any more stringent state ARARs that pertain to Industri-plex OU-2. See the tables in Appendix D for a list of all ARARs and To Be Considered requirements for the selected remedy.

3. The Selected Remedy is Cost-Effective

In EPA's judgment, the selected remedy is cost-effective because the remedy's costs are proportional to its overall effectiveness (see 40 CFR 300.430(f)(1)(ii)(D)). This determination was made by evaluating the overall effectiveness of those alternatives that satisfied the threshold criteria (i.e., that are protective of human health and the environment and comply with all federal and any more stringent ARARs). Overall effectiveness was evaluated by assessing three of the five balancing criteria: long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness, in combination. The overall effectiveness of each alternative then was compared to the alternative's costs to determine cost-effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs and hence represents a reasonable value for the money to be spent.

For groundwater, EPA has determined that the Limited Action Alternative (GW-2: Pond Intercept with Monitoring and Institutional Controls) is the most cost effective alternative as it meets the threshold criteria and is reasonable given the relationship between the overall effectiveness afforded by the other alternative and cost compared to other available options. In evaluating the differences between the Limited Action Alternative and the Active remediation alternative, the decisive factors were that 1) the Industri-plex OU-1 source of contamination (i.e. soils and hide piles) will not be removed, consequently the groundwater will remain contaminated indefinitely; 2) the MassDEP has determined that the aquifer is of "low use and value;" 3) institutional controls would still be required by both the Limited Action and the Active Remediation Alternative. Finally, the Limited Action Alternative has fewer short-term impacts than the Active Remediation Alternative on the community.

For the sediment cleanups in near shore sediment areas (Wells G&H Wetland and the Cranberry Bog Conservation Area), EPA has determined that the Active Remediation Alternatives are cost effective as they meet both threshold criteria and are reasonable given the relationship between the overall effectiveness afforded by the other alternative and cost compared to other available options. In evaluating the differences between the No Action Alternatives and the Active Remediation Alternatives, the decisive factors were that the Active Remediation Alternatives provide greater long-term protectiveness and permanence and unlike the No Action Alternatives, reduce toxicity, mobility, and volume, although not through treatment. Finally, while the No Action Alternatives have no short-term impacts when compared with the Active Remediation Alternatives, the difference is not significant given that the types of impacts from the Active Remediation Alternatives are typical during cleanup operations and can be minimized or eliminated through routine, standard operating procedures.

For sediments in the HBHA Pond, EPA has determined that the Active Remediation Alternative is cost effective as they meet both threshold criteria and are reasonable given the relationship between the overall effectiveness afforded by the other alternative and cost compared to other available options. In evaluating the differences between the No Action Alternatives and the Active Remediation Alternatives, the decisive factors were that the Active Remediation Alternatives provide greater long-term protectiveness and permanence and unlike the No Action Alternatives, reduce toxicity, mobility, and volume, although not through treatment. Finally, while the No Action Alternatives have no short-term impacts when compared with the Active Remediation Alternatives, the difference is not significant given that the types of impacts from the Active Remediation Alternatives are typical during cleanup operations and can be minimized or eliminated through routine, standard operating procedures.

For sediments in deep, interior portions of the HBHA Wetlands and Wells G&H Wetland, EPA has determined that the Limited Action Alternative is the most cost effective alternative as it meets the threshold criteria and is reasonable given the relationship between the overall effectiveness afforded by the other alternative and cost compared to other available options. In evaluating the differences between the Limited Action Alternative and the Active Remediation alternative, the decisive factors were that 1) the exposure pathway is limited to a possible future dredger, which can be protected through safe construction methods, practices, and training; 2) the extent of contamination requiring remediation would impact a larger area (over 35 acres) of wetland habitat; 3) the Active Remediation alternative would be cost prohibitive; and 4) the

Active Remediation Alternative would have significant short-term impacts on the community compared to the Limited Action Alternative.

For surface and subsurface soils in the vicinity of the former Mishawum Lake, EPA has determined that the Limited Action Alternative is the most cost effective alternative as it meets the threshold criteria and is reasonable given the relationship between the overall effectiveness afforded by the other alternative and cost compared to other available options. In evaluating the differences between the Limited Action Alternative and the Active Remediation alternative, the decisive factors were that 1) the exposure pathway is limited to a possible construction worker, which can be protected through safe construction methods, practices, and training and a future day care child, which can be protected through land use restrictions; 2) Both Limited Action and Active Remediation would still require institutional controls since some contaminated soils would be left in-place mostly under buildings and bituminous parking lots and streets for surface soils, and 3) the Active Remediation Alternative would have significant short-term impacts on the community compared to the Limited Action Alternative.

For surface water in the HBHA Pond, EPA has determined that, coupled with the Active Remediation for sediments in the HBHA Pond, the Limited Action Alternative is the most cost effective alternative as it meets the threshold criteria and is reasonable given the relationship between the overall effectiveness afforded by the other alternative and cost compared to other available options. In evaluating the differences between the Limited Action Alternative and the Active Remediation alternative, the decisive factors were that 1) continued contaminated groundwater discharges will attenuate through natural processes; 2) the Active Remediation alternative would rely on a more extensive and costly groundwater remediation alternative to completely eliminate contaminated groundwater discharges into the HBHA Pond to prevent re-contamination; 3) the creation of an alternate habitat will enhance the ecological diversity in the watershed and may help to mitigate flood storage losses; 4) the Active Remediation alternative would be cost prohibitive, and 5) the Active Remediation Alternative would have significant short-term impacts on the community compared to the Limited Action Alternative.

4. The Selected Remedy Utilizes Permanent Solutions and Alternative Treatment or Resource Recovery Technologies to the Maximum Extent Practicable

Once the Agency identified those alternatives that attain ARARs and that are protective of human health and the environment, EPA identified which alternative utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. This determination was made by deciding which one of the identified alternatives provides the best balance of trade-offs among alternatives in terms of: a) long-term effectiveness and permanence; b) reduction of toxicity, mobility or volume through treatment; c) short-term effectiveness; d) implementability; and e) cost. The balancing test emphasized long-term effectiveness and permanence and the reduction of toxicity, mobility and volume through treatment; and considered the preference for treatment as a principal element, the bias against off-site land disposal of untreated waste, and community and state acceptance. The selected remedy provides the best balance of trade-offs among the alternatives.

a. Long-term Effectiveness and Permanence:

- Surface Soil (SS): The No Action Alternative, SS-1, does not provide any long-term effectiveness or permanence. The Preferred Alternative, SS-2, would provide long-term effectiveness and permanence through institutional controls. Alternative SS-3 would provide additional long-term effectiveness and permanence through institutional controls prohibiting disturbance of the cover. Alternatives SS-4 and SS-5 provide the highest degree of long-term effectiveness and permanence because the contaminated soil would be removed.

- Subsurface Soil (SUB): The No Action Alternative, SUB-1, does not provide any long-term effectiveness or permanence. The Preferred Alternative, SUB-2, would provide long-term effectiveness and permanence through institutional controls. Alternative SUB-3 would also provide long-term effectiveness and permanence through institutional controls prohibiting disturbance of the cover.

- Groundwater (GW): The No Action Alternative, GW-1, does not provide any long-term effectiveness or permanence. GW-2, the Preferred Alternative, would provide long-term effectiveness and Alternatives GW-3 and GW-4 would also be effective in the long-term, however GW-3 would require more extensive operation and maintenance then GW-4.

- Halls Brook Holding Area Pond Sediments (HBHA): The No Action Alternative, HBHA-1, does not provide any long-term effectiveness or permanence. Alternative HBHA-2 would provide marginal long-term effectiveness and permanence, and long-term monitoring would be required to evaluate risks associated with contaminants left in place. Alternative HBHA-3 would provide enhanced long-term effectiveness and permanence provided there is no erosion of the permeable cover and contamination from groundwater discharges is eliminated. The Preferred Alternative, HBHA-4, provides a greater level of long-term effectiveness since a majority of contaminated sediments would be removed from the southern portion of HBHA Pond. Alternative HBHA-5 provides the highest level of long-term effectiveness and permanence because the contaminated sediment would be removed off-site.

- Near Shore Sediments (NS): The No Action Alternative, NS-1, does not provide any long-term effectiveness or permanence. Alternatives NS-2 and NS-3 would provide long-term effectiveness and permanence through institutional controls. The Preferred

Alternative, NS-4, provides the highest degree of long-term effectiveness and permanence because the sediments exceeding the cleanup standards would be excavated.

- Deeper Wetland Sediments (DS): The No Action Alternative, DS- 1, does not provide any long-term effectiveness or permanence. The Preferred Alternative DS-2, would provide long-term effectiveness and permanence through institutional controls. Alternative DS -3 provides the highest degree of long-term effectiveness and permanence because the sediments exceeding the cleanup standards would be excavated.

- Surface Water (SW): The No Action Alternative, SW-1, does not provide any long-term effectiveness or permanence. The Preferred Alternative, SW-2, which includes monitoring, and Alternative SW-3, which also includes monitoring provides greater long-term effectiveness. Alternative SW-3 provides the greatest level of permanence by creating an alternate wetlands habitat.

b. Reduction of toxicity, mobility or volume through treatment

- Surface Soil (SS): The No Action Alternative, SS-1, the Preferred Alternative, SS-2, and Alternative SS-3 do not include treatment. Alternative SS-4 may provide limited off-site treatment, if necessary, to qualify for disposal at a licensed landfill. Alternative SS-5 reduces the toxicity and mobility of the contaminants by using a "soil washing" process to remove arsenic from the soil before using the treated soil as backfill.

- Subsurface Soil (SUB): The No Action Alternative, SUB-1, the Preferred Alternative, SUB-2, and Alternative SUB-3 do not reduce toxicity, mobility or volume through treatment or other means.

- Groundwater (GW): The No Action Alternative, GW-1, offers no treatment other than long-term natural attenuation processes that may occur with organic contaminants. The Preferred Alternative, GW-2, controls the migration of contaminated groundwater by intercepting contamination at the HBHA Pond, and makes use of the naturally occurring processes in HBHA Pond to precipitate metals and degrade organic contaminants. Alternative GW-2 does not actively treat groundwater prior to discharge to HBHA Pond, except for natural attenuation processes that may occur. When combined with Alternative HBHA-4, as EPA is proposing to do, GW-2 would control or reduce downstream migration of inorganic contaminants during storm events. Both Alternatives GW-3 and GW-4 employ technologies to prevent contaminated groundwater from discharging into HBHA Pond and also destroy or remove target contaminants from the groundwater. Alternative GW-3 is an ex-situ system while Alternative GW-4 is an in-situ design. Both technologies are able to reduce the toxicity, mobility and volume of contaminants in the groundwater and both treatment processes are irreversible.

- Halls Brook Holding Area Pond Sediments (HBHA): The No Action Alternative, HBHA-1, HBHA-2, and HBHA-3 do not treat contaminants. Alternative HBHA-3 reduces the mobility of contaminated sediments by placing a cap over them. The Preferred Alternative, HBHA-4, and Alternative HBHA-5 may include limited off-site treatment of dredged sediments, if necessary, to qualify for disposal at a licensed landfill. HBHA-4 also reduces the mobility of contaminated sediments by creating a retention area where contaminated sediments are contained and periodically removed.

- Near Shore Sediments (NS): The No Action Alternative, NS-1, and Alternatives NS-2 and NS-3 do not treat contaminants. Alternatives NS-2 and NS-3 may reduce mobility in the long-term if contaminated sediments are buried by the accumulation and deposition of uncontaminated sediments. The Preferred Alternative, NS-4, may include limited off-site treatment if necessary to qualify for disposal at a landfill.

- Deeper Wetland Sediments (DS): The No Action Alternative, DS-1 and the Preferred Alternative, DS-2, do not treat or reduce the toxicity of the deeper wetland sediments, unless other alternatives are implemented upstream to reduce downstream contaminant migration and clean sediments are given an opportunity to accumulate and deposit on top of contaminated sediments, in essence may include limited off-site treatment, if necessary, to qualify for disposal at a licensed landfill.

- Surface Water (SW): The No Action Alternative, SW-1, the Preferred Alternative, SW-2, and Alternative SW-3 do not include treatment.

c. Short-term effectiveness:

- Surface Soil (SS): The No Action Alternative, SS-1, would not be effective in the short-term or cause any short-term impacts because the alternative does not require any action. Alternatives SS-2 and SS-3, which call for the installation of institutional controls, will effectively limit risks to human health in the short-term. In addition, the cover required as part of SS-3 will become effective upon its construction. Alternatives SS-4 and SS-5 will become effective once the contaminated soils are excavated and disposed of off-site or treated. The Preferred Alternative, SS-2, would have limited impacts on property owners where institutional controls restrict land use. Alternatives SS-3, SS-4, and SS-5 would have the most short-term impacts on the community, including an increase in traffic during construction activities. Impacts to workers would be minimal since construction activities would be completed in accordance with appropriate health and safety procedures and potential risks and hazards associated with fugitive dust emissions would be addressed with prescribed engineering controls. No adverse environmental impacts are anticipated from any alternative.

- Subsurface Soil (SUB): The No Action Alternative, SUB-1, would not be effective in the short-term or cause any short-term impacts because the alternative does not require any action. Alternatives SS-2 and SS-3 which call for the installation of institutional controls will effectively limit risks to human health in the short-term. In addition, the permeable cover required as part of SS-3 will become effective upon its construction. The Preferred Alternative, SUB-2, would have limited impacts on property owners where institutional controls restrict land use. Alternative SUB-3 would have the most significant short-term impacts on the community including an increase in traffic during construction activities. Impacts to individual property owners would be significant since large portions of property would require a soil cover and the use of parking areas and road ways would be temporarily restricted. Impacts to workers would be minimal since construction activities would be completed in accordance with appropriate health and safety procedures and potential risks and hazards associated with fugitive dust emissions would be addressed with prescribed engineering controls. No adverse environmental impacts are anticipated from any alternative.

- Groundwater (GW): The No Action Alternative, GW-1, would not be effective in the short-term or cause any short-term impacts because the alternative does not require any action. Alternative GW-2, the Preferred Alternative, and Alternatives GW-3 and GW-4 which call for the installation of institutional controls will effectively limit risks to human health in the short-term. The Preferred Alternative, GW-2, would have limited impacts on property owners since the imposition of institutional controls would restrict groundwater use. Alternatives GW-3 and GW-4 would have limited short-term impacts on the community, including an increase in traffic during construction activities. Fugitive dust emissions would be addressed with engineering controls. Alternatives GW-3 and GW-4 may have limited adverse environmental impacts during construction, however engineering controls and approved construction methods would be used to minimize these risks.

- Halls Brook Holding Area Pond Sediments (HBHA): The No Action Alternative, HBHA-1, would not be effective in the short-term or cause short-term impacts because the alternative does not require any action. Alternative HBHA-2 would not cause any short-term impacts to the community because the alternative only requires monitoring. Alternative HBHA-3, the Preferred Alternative, HBHA-4, and

Alternative HBHA-5 would have the most short-term impacts on the community including an increase in traffic during construction activities. Fugitive dust emissions would be addressed with engineering controls. Alternative HBHA-3 would have potential significant environmental impacts from the displacement and migration of contaminated sediments during the placement of the cap. However, these potential risks could be minimized through engineering controls that minimize and control suspended solids. The Preferred Alternative, HBHA-4, and Alternative HBHA-5 would have the most significant short-term environmental impacts due to the dredging activities. Benthic communities destroyed during the sediment removal would re-establish themselves over time.

- Near Shore Sediments (NS): The No Action Alternative, NS-1, would not be effective in the short-term or cause any short-term impacts because the alternative does not require any action. Alternatives NS-2 and NS-3 would have minor impacts on the community and workers installing protective fencing. The Preferred Alternative, NS-4, would have the most short-term impacts on the community, including an increase in traffic during construction activities as well as an increase in organic odors while excavating along shoreline wetlands. Fugitive dust emissions would be minimized and addressed with engineering controls. Alternative NS-4 would also cause short-term environmental impacts during excavation restoration of the wetland. These impacts would be minimized by engineering controls. Benthic communities destroyed during the sediment removal would re-establish themselves over time.

- Deeper Wetland Sediments (DS): The No Action Alternative, DS-1, and the Preferred Alternative, DS-2, would not cause any short-term impacts to the community or on-site workers because the alternatives do not require any action. Alternative DS-3 would have the most significant short-term impacts on the community and surrounding businesses, including an increase in traffic during construction activities, as well as an increase in organic odors while excavating in the wetlands. Impacts to individual property owners would be significant since large portions of property would be utilized to implement the alternative. Fugitive dust emissions would be minimized and addressed with engineering controls. Alternative DS-3, which requires constructing haul roads, potential cofferdams and intrusions into the wetland areas to access deep sediments, would cause extensive and severe environmental impacts. These impacts would be minimized by engineering controls during the remediation. Benthic communities and other wetland habitat features that are destroyed during sediment removal would eventually re-establish themselves over time.

- Surface Water (SW): The No Action Alternative, SW-1, would not cause any short-term impacts to the community or on-site workers because the alternative does not require any action. The Preferred Alternative, SW-2, would not cause any short-term impact on the community. Alternative SW-3 would have the most short-term impacts to the community due to the construction of an alternate wetlands habitat.

d. Implementability:

- Surface Soil (SS): The No Action Alternative, SS-1, would be the easiest to implement because there are no remedial actions required. The Preferred Alternative, SS-2, would be the next easiest to implement. Alternatives SS-3, SS-4 and SS-5 would be more difficult than the other alternatives due to the area requiring remediation, the proximity to active commercial and light industrial properties, and the additional construction activities associated with these alternatives.

- Subsurface Soil (SUB): The No Action Alternative, SUB-1, would be the easiest to implement because there are no remedial actions. The Preferred Alternative, SUB-2, would be the next easiest to implement. Alternative SUB-3 would be more difficult than the other alternatives due to the area requiring remediation, the proximity to active commercial and light industrial properties, and the additional construction activities associated with this alternative.

- Groundwater (GW): The No Action Alternative, GW-1, is the easiest to implement because there are no remedial actions required. The Preferred Alternative, GW-2, would be the next easiest to implement. Alternative GW-3 would be more difficult than Alternative GW-2 due to the complexities involved with a multi-process treatment system and typical construction issues. However, technologies for Alternative GW-3 are reliable and proven. Alternative GW-3 requires more extensive operation and maintenance than any other alternative and would likely require a full-time treatment plant operator. Alternative GW-4 could be the most difficult to implement due to the deep excavations required to install the reactive wall and uncertainties associated with the technology. However, these uncertainties may be addressed during the pre-design investigation.

- Halls Brook Holding Area Pond Sediments (HBHA): The No Action Alternative, HBHA-1, would be the easiest to implement because there are no remedial actions required. Alternative HBHA-2 would be the next easiest since it only involves collecting sediment samples. Alternative HBHA-3, the Preferred Alternative, HBHA-4, and Alternative HBHA-5 would be more difficult than Alternatives HBHA-1 and HBHA-2 due to the construction activities involved in these alternatives, including dredging, water treatment, sediment dewatering, and the need for specialized equipment and skilled workers. The Preferred Alternative, HBHA-4, is more difficult than Alternative HBHA-5 because it is further compounded by the construction of a sediment retention area (primary and secondary treatment cells) and larger compensatory wetlands. All alternatives except the Preferred Alternative, HBHA-4, require that contaminated groundwater discharges be eliminated prior to constructing the remedy so that the excavated or capped areas do not become re-contaminated.

- Near Shore Sediments (NS): The No Action Alternative, NS-1, would be the easiest to implement because there are no on-site remedial actions required. Alternatives NS-2 and NS-3 would be the next easiest since the only activities required are posting fences and signs. Alternative NS-3 would also include periodic sampling of surface water and sediment. The Preferred Alternative, NS-4, would be more difficult than the others due to the excavation, dewatering, water treatment and wetlands restoration activities involved in this alternative.

- Deeper Wetland Sediments (DS): The No Action Alternative, DS-1, and the Preferred Alternative DS-2 would be the easiest to implement because there are no on-site remedial actions required. Alternative DS-3 would be the most difficult to complete due to the complexities involved in accessing the interior portions of the wetlands with heavy equipment to conduct the excavation, dewatering, water treatment and wetlands restoration activities involved in this alternative.

- Surface Water (SW): The No Action Alternative, SW-1, and the Preferred Alternative, SW-2, would be the easiest to implement because there are no on-site remedial actions required. The Preferred Alternative, SW-2, would require additional effort associated with monitoring. Alternative SW-3 would be the most difficult to implement due to locating and constructing an alternate wetlands habitat.

5. The Selected Remedy Does Not Satisfy the Preference for Treatment as a Principal Element

The principal elements of the selected remedy are management of migration of the groundwater, removal and disposal of sediments in near shore sediments (Cranberry Bog Conservation Area and Wells G&H Wetland) and southern portion of the HBHA Pond, source control of sediments in the HBHA Pond, source control of soils, and source control of surface water. These elements address the primary threats at Industri-plex OU-2: risks to human health from groundwater and risks to human health and ecological receptors from sediment, risks to human health from soil, risks to ecological receptors from surface water.

The selected remedy does not satisfy the statutory preference for treatment as a principal element by using treatment to address contaminated media. For groundwater, the previous Operable Unit capped over 105 acres of contaminated soils that are serving as the source of groundwater contamination. Groundwater treatment would be ineffective and impractical given that the source will not be addressed, excluding benzene source at the West Hide Pile (see selected remedy component GW-4 for the West Hide Pile which may implement In-situ Enhanced Bioremediation). For soil, source excavation and treatment was determined to be impractical and impose significant impacts to the local community since the area where the contamination exists is occupied by intensely developed commercial and light industrial properties. For sediments, no effective in-situ remedial technology exists and the extensive volume of material that would require removal for ex-situ treatment would be impractical as well as impacting an extensive area of wetlands and river. For surface water, since contamination is the result of groundwater discharges, extraction and treatment of the entire HBHA Pond would be required and is impractical.

6. Five-Year Reviews of the Selected Remedy are Required.

Because this remedy will result in hazardous substances remaining on-site above levels that allow for unlimited use and unrestricted exposure, a review will be conducted within five years after initiation of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

Performance monitoring data for the selected remedy will be closely monitored to ensure compliance (e.g. contaminated groundwater plumes capture and natural contaminant treatment/ sequestering by the primary treatment cell; further contaminant treatment/sequestering by the southern treatment cell to surface water cleanup limits at the outlet of the secondary cell; reduction of contaminant migration downstream of HBHA Pond so that contaminants do not cause unacceptable human health or ecological risks in the future; etc). In addition, some public comments received during the public comment periods proposed remedial action activities in the HBHA Wetlands. EPA's selected remedy for deeper interior wetlands of the HBHA Wetlands requires the implementation of institutional controls to restrict potential future human exposures to sediments under selected alternative DS-2. Notwithstanding this selected remedy, EPA will closely monitor and evaluate monitoring data from the HBHA Wetland during the Five Year Review process to determine if any further actions may be necessary.

N. DOCUMENTATION OF NO SIGNIFICANT CHANGES

In accordance with EPA Guidance 540-R-98-031, OSWER 9200.1-23.P, entitled: *A Guide To Preparing Superfund Proposed Plans, Records of Decision and Other Remedy Selection Decision Documents*, dated July 1999, and NCP 300.430(f)(3)(ii) documentation in the ROD is needed for "significant changes that could have been reasonably anticipated based on the information available to the public."

<u>June 2005 Proposed Plan, OU-2</u>

EPA presented a Proposed Plan for remediation contaminated groundwater, sediments, soil, and surface water for Industri-plex OU-2 on June 30, 2005, which included the following components:

- Dredging and off-site disposal of contaminated sediments in the southern portion of the Halls Brook Holding Area (HBHA) Pond and the near shore sediments at the Wells G&H Wetland and Cranberry Bog Conservation Area, and restoration of all disturbed areas. This component will address sediments posing an unacceptable human health risks for near shore sediments and ecological risks for the southern portion of HBHA Pond.

- The northern portion of Halls Brook Holding Area (HBHA) Pond will be incorporated into the cleanup plan and serve as a sediment retention area that will intercept groundwater plumes (e.g. arsenic, benzene, ammonia) originating from Industri-plex OU-1 and minimize downstream migration of contaminants (e.g. arsenic). The northern portion will be separated from the southern portion by various cofferdams (primary and secondary treatment cells), and storm water from Halls Brook will be diverted to the southern portion of HBHA Pond. Natural and aeration treatment processes will be used to reduce and/or settle contaminants within the northern portion. Sediments that accumulate in the northern portion of the HBHA Pond will be dredged periodically and sent off-site for disposal. The most downstream cofferdam (outlet of the secondary treatment cell) will serve as the compliance boundary for the groundwater and surface water captured by the northern portion of the HBHA Pond, and achieve surface water cleanup standards (e.g. National Recommended Water Quality Criteria, benchmarks.

- In-situ Enhanced Bioremediation of groundwater plumes (e.g. benzene) at the West Hide Pile (WHP).

- Capping (impermeable) and stabilizing sediments along New Boston Street Drainway to prevent the discharge of groundwater plumes, the downstream migration of contaminants and erosion, all of which could potentially compromise preferred alternative HBHA-4 and NS-4.

- Capping (permeable) and stabilizing soils adjacent to the NSTAR and MBTA rights-of-way to prevent downstream migration of contaminants, which could potentially compromise the preferred alternatives HBHA-4 and NS-4.

- Establishing institutional controls to ensure that no one comes into contact with soils, groundwater, or deeper wetland sediments above cleanup standards.

- Any loss of wetlands (e.g. northern portion of HBHA Pond, capped sediments) will be compensated for elsewhere in the watershed.

- Long-term monitoring of the groundwater, surface water, and sediments.

After further review of the data and in response to comments from the community and the state, EPA added ammonia as an additional contaminant of concern. The ammonia data was further presented and evaluated in the October 2005 Technical Memorandum and also presented in the October 2005 Fact Sheet, which supplemented the June 2005 Proposed Plan. This additional contaminant will be addressed by the remedial alternatives described in the Proposed Plan and does not require any modification to the selected remedy. EPA reviewed all written and verbal comments submitted during the public comment period. It was determined that no significant changes to the remedy, as originally identified in the Proposed Plan, were necessary.

O. STATE ROLE

The Commonwealth of Massachusetts Department of Environmental Protection has reviewed the various alternatives and has indicated its support for the selected remedy. The State has also reviewed the MSGRP RI, Risk Assessment and MSGRP FS to determine if the selected remedy is in compliance with applicable or relevant and appropriate State environmental and facility siting laws and regulations. The Commonwealth of Massachusetts concurs with the selected remedy outlined in this Record of Decision. A copy of the declaration of concurrence is attached as Appendix A.

PART 3: THE RESPONSIVENESS SUMMARY

There has been extensive community participation during the Remedial Investigation/Feasibility Study process for the Industri-plex Superfund Site Operable Unit 2 (including Wells G&H Superfund Site Operable Unit 3, Aberjona River Study), "Industri-plex OU-2." A more detailed summary of community coordination and involvement is outlined in Section C of Part 2 of the ROD, Community Participation.

EPA held a public information meeting on April 28, 2005, describing the results of the March 2005 MSGRP RI Report and schedule for the Proposed Plan. EPA released its Proposed Plan and Administrative Record to the public on June 30, 2005, initiating a 30-day comment period from July 1 - 31, 2005, and published a legal notice of the Proposed Plan in the Woburn Daily Times Chronicle on June 28, 2005. EPA also held a public information session on June 30, 2005 at the Shamrock School in Woburn, Massachusetts. On July 15, 2005, EPA extended the comment period an additional 30 days at the request of the public, concluding the 60 day comment period on August 30, 2005. EPA held a Public Hearing on July 27, 2005 at the Shamrock School. A transcript was created for the July 2005 Public Hearing and has been made part of the Administrative Record for this Record of Decision.

During the comment period, many parties requested additional extensions. After initial review of the comments, EPA reopened the comment period an additional 30 days from October 20, 2005 to November 18, 2005 and released the Technical Memorandum – Evaluation of Ammonia and Supplemental Soil Data report, a Fact Sheet supplementing the June 2005 Proposed Plan, and the Supplemental Administrative Record. An additional Public Hearing was held on November 17, 2005 at the Shamrock School. A transcript was created for the November 2005 Public Hearing and has been made part of the Administrative Record for this Record of Decision.

In addition to oral comments provided during the Public Hearings, numerous written comments were provided on the Proposed Plan. The full text of all written and oral comments received during the comment period has been included in the Administrative Record.

Outlined below is a summary of significant comments received from the public and other interested parties during the public comment periods and EPA's response to those comments. Similar comments have been summarized and grouped together and technical and legal issues have been divided into a number of general categories. These general categories are summarized as follows:

A. Questions and Comments Regarding Remedy Section Process
B. Questions and Comments Regarding Institutional Controls
C. Questions and Comments Concerning the Impact of Flooding on the Remedy and Concerning the Upper Mystic Lake
D. Questions and Comments Concerning Human Health and Ecological Risk Assessments
E. Questions and Comments Concerning the Preferred Remedy
F. Questions and Comments Concerning the Scope of Feasibility Study
G. Questions and Comments Concerning Monitoring and Ongoing Review of the Remedy

H. Questions and Comments Concerning ARARs
I. EPA's Response to SMC and Pharmacia's Alternative Proposed Plan
J. Questions and Comments Regarding Liability and Enforcement
K. Questions and Comments Regarding Errors or Omissions in the Feasibility Study

A. Questions and Comments Regarding Remedy Selection Process

A. 1. Multiple requests were made for extensions to the 30-day public comment period.

EPA Response: The comment period, which was originally due to end on July 31, 2005, was extended by 30 days to August 30, 2005, and then reopened for an additional 30 days, from October 20, 2005 to November 18, 2005 in response to requests by the community and other stakeholders.

A. 2. The City and others requested that a "peer review" of the Proposed Plan be conducted.

EPA Response: The City of Woburn was granted assistance via the Technical Outreach Services for Communities (TOSC) program for evaluating and understanding technical documents such as the Remedial Investigation and Proposed Plan. In addition, a $100,000 Technical Assistance Grant (TAG) was issued to the Aberjona Study Coalition (ASC). EPA believes that, with this assistance, the City of Woburn and the ASC have been supplied with sufficient expertise to review the proposal, as evidenced by their comments submitted on the Proposed Plan.

A. 3. Congressman Markey inquired whether the Town of Winchester had been involved in the remedy selection process, and whether the Army Corps of Engineers had been consulted regarding the proposed remedy.

EPA Response: The Town of Winchester has been notified of every report, decision and public meeting which has taken place during the formulation of the Proposed Plan. The Town of Winchester provided written comments on the Proposed Plan expressing appreciation and continued cooperation. With regard to flooding, EPA will coordinate all work that is performed in the Aberjona River floodplain with the Army Corps of Engineers. This work must meet all applicable or relevant and appropriate laws and regulations governing such work, including Section 404 of the Clean Water Act and the Executive Order for Floodplain Management, Exec. Order 11988 (1977), codified at 40 C.F.R. Part 6, App. A., 40 CFR 6.302(b).

A. 4. The Industri-plex Custodial Trust ("Custodial Trust") requested a "60 day moratorium on the CERCLA enforcement process. During this time, the beneficiaries of the Custodial Trust could meet in an effort to establish a more collaborative framework for implementing the Aberjona River clean-up." The Custodial Trust also characterized its obligations under the 1989 Consent Decree "...to serve the fiduciary and other needs of the three distinct beneficiaries of the Custodial Trust. They are the City of Woburn, the potentially responsible parties known as the Remedial Trust and the U.S. EPA and the MassDEP. In continued fulfillment of our obligations to these three beneficiaries, the